RAILROAD GAZETTE

FRIDAY, JANUARY 11, 1878.

The Billerica & Bedford Two-Feet Gauge Railroad.

II.

With this number of the *Railroad Gazette* complete engravings of the locomotives used on this road are given. These engines were built by the Hinkley Locomotive Works, of Boston, and are constructed on the plan proposed and patented by Mr. M. N. Forney. The designs were, however, worked out by Mr. F. D. Child, the Superintendent of the works where they were built. This was done with so much skill and good taste that the engines have excited general admiration, and since they have been put into service they have worked in the most satisfactory manner.

Although the objects aimed at in the design of this engine have been frequently described, a few words regarding it may not be amiss here.

It is a fact well known by all experienced railroad engineers, that a four-wheeled switching engine like that represented in fig. 7, which has the whole weight of the boiler and machinery on the driving-wheels, and weighing say twenty tons, will pull as great a load as an eight-wheeled or "American" engine like that shown in fig. 8, and weighing 50 per cent. more, or thirty tons. The reason for this is that about one-third of the weight of the latter is on the leading truck, whereas the whole weight of the four-wheeled engine is on the driving-wheels.

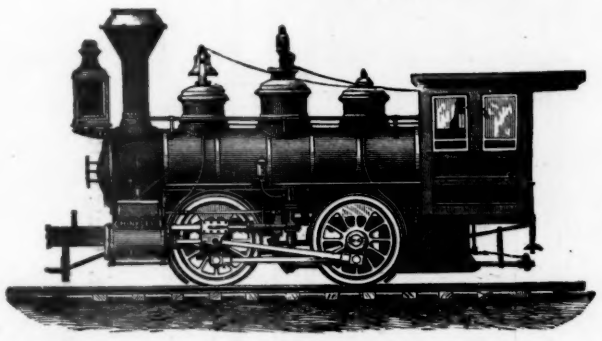

Fig. 7.

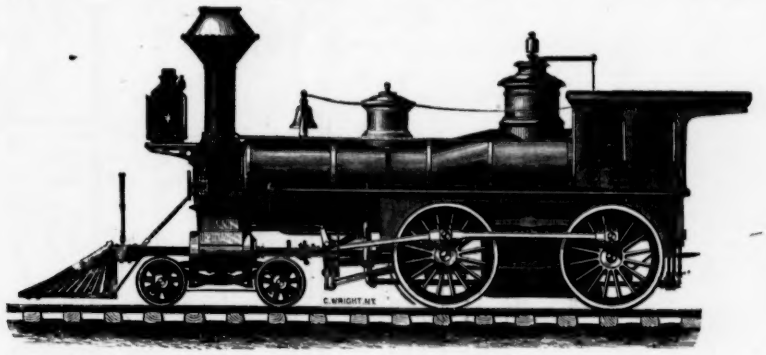

Fig. 8.

The question would then very naturally arise why not use the four-wheeled locomotive for ordinary traffic? The objection to doing so is that the wheel-base of such an engine must necessarily be comparatively short, and therefore it is unsteady when running at a high rate of speed or on a rough track. If it be asked why the wheel-base might not be lengthened and the whole weight of the engine still retained on the driving wheels, it may be said that in order to utilize the whole weight on the wheels, it is necessary to connect them to each other by cranks and rods, so as to revolve together. The crank-pins must, then, always be the same distance apart, and the axles, therefore, be held in a position parallel to each other. But if a pair of wheels attached to an axle roll on a curved track, the position of the centre line of the axle should conform to that of the radii of the curve, in order that the wheels may always be parallel to, and roll in a line with, the rails. If the axles are not radial to the curves, the flanges of the wheels will come in contact with the rails at an angle, and the abrasion of both is in proportion to the inclination of the one to the other. If two or more pairs of wheels are connected together by cranks and rods, and the axles are consequently attached to a frame and held rigidly parallel to each other, and the wheels are rolled on a curved track, it is obvious that *all* the axles, being parallel, cannot conform to the radii of the curve. The greater the distance apart of the axles, the more will be their divergence from the radii and the greater the inclination of the wheels to the rails.*

Consequently, if the wheel-base of a locomotive is lengthened, by placing the driving axles far apart, the injury to the rails on curves by the abrasion of the flanges of the wheels, and the danger of running off the track, will be increased. If the axles are placed near together, the wheel-base will be short, and at high speeds or on a rough road the motion will be inconveniently and dangerously unsteady. This is illustrated by an ordinary horse-car, the wheels of which in order to pass around short curves easily are placed near together, and it therefore acquires a peculiar leaping motion in running rapidly over frogs, switches, or other uneven places on the track. The speed of both street-cars and switching locomotives is, however, comparatively slow, so that their unsteadiness is of little consequence. At higher speeds it would become dangerous, and for this reason four-wheeled locomotives are seldom or never used on ordinary steam roads in this country for any other purpose excepting for switching cars or other slow traffic.

In order to obviate this evil and to secure the desired steadiness of locomotives by providing a long wheel-base, while at the same time avoiding the evils attending the use of axles placed far apart and held rigidly parallel to each other, "bogies" or trucks, shown in fig. 8, have come into almost universal use in this country for all locomotives intended to run at high rates of speed. They consist of one or two pairs of wheels and axles attached to a separate frame, which is connected to the locomotive by a centre-pin, which allows the whole truck to vibrate or turn around the pin—similar to the movement of the front axle of a common road-wagon or carriage; and, consequently, the wheels and axles of the truck can adjust themselves to the curvature of the track, no matter what the length of the wheel-base may be.

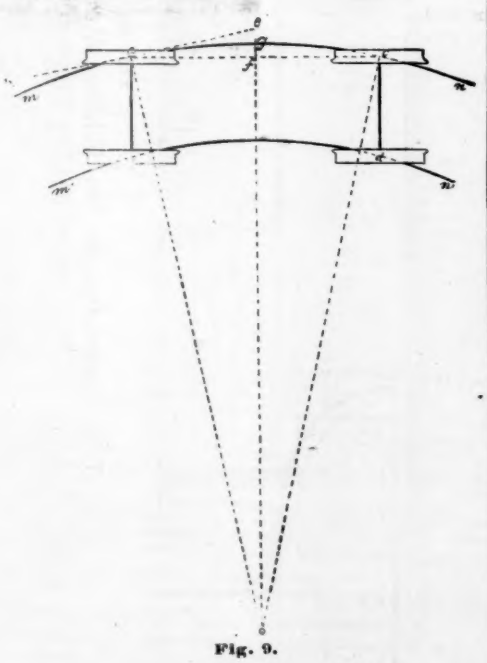

Fig. 9.

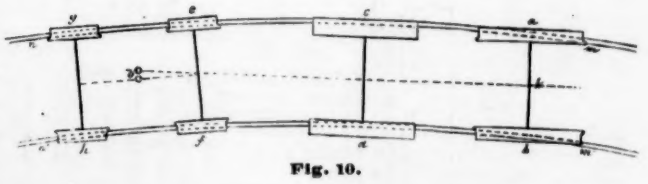

Fig. 10.

A plan of the wheels, arranged in this way, is shown in fig. 10—in which *a*, *b*, *c*, *d* are the driving-wheels, and *e*, *f*, *g*, *h* the truck-wheels, *o* the centre about which the truck turns, and *m n m' n'* a curved track. It is apparent from the diagram that by turning on the centre-pin the truck can adjust itself to the curvature of the track, and the wheels of the truck being comparatively near together, its wheel-base is short, and therefore the angle of the wheels to the rails is very small. The engine is therefore guided by wheels which are at all times very nearly parallel to the rails. The abrasion of the latter by the wheel-flanges, and the danger of getting off the rails are consequently very slight.

As has been stated, in such engines the truck carries about one-third the weight of the locomotive, lessening thereby the load on the driving-wheels, and in the same proportion, the capacity of the engine for drawing loads. Therefore, when a truck is used in the ordinary way one-third of the adhesive weight of the locomotive is lost. Railroad engineers in this country have decided, however, that the increased steadiness and ease of passing curves gained by using a long wheel-base and a truck for the leading wheels compensates for the loss of adhesive weight, and the great majority of locomotives now in use here have such trucks in front, which act as guides, and which carry one-third or more of the weight of the engine.

Some years ago Mr. Forney devised and patented the plan which has been adopted for the engine for the Bedford & Billerica road, and is shown in the full-page plate and the other engravings, by which all the weight of the boiler and machinery is carried on the driving-wheels, just as it is carried by ordinary four-wheeled engines, represented by fig. 7; but by extending the frames backward or beyond the fire-box, as shown in the perspective view and the other engravings, room was provided for carrying the water or fuel, or both, on this frame, and a truck was then placed underneath it to carry the weight of the water and fuel, which, of course, made it possible to dispense with a tender, and at the same time the weight of fuel, water, water-tank, etc., served to keep the truck on the track. In this way the whole weight of the boiler, machinery, etc., which is *permanent* or *unchangeable*, is carried on the driving-wheels, where it is available for adhesion, and the weight of the water or fuel, or both, which is variable, is on the truck. Much importance is assigned to this latter feature. If the weight on the driving-wheels consists partly of that of the fuel and water carried, then the adhesion of the engine will be reduced as these are consumed. If, however, the fuel and water are carried on the truck and the weight of the boiler and machinery on the driving-wheels, then the adhesion is due to the *permanent* weight, and is therefore *constant*, while at the same time the wheel-base is sufficiently long and flexible to give the requisite steadiness and to pass around curves with ease.

It has been explained that with a long wheel-base it is desirable to have a truck which can turn on a centre-pin, and adjust itself to the curvature of the track to guide the engine. For this reason Mr. Forney proposed to run locomotives of his plan with the truck in front, or the reverse direction of that in which locomotives are usually run, and this recommendation has been adopted in the construction and in operating the engines for the Bedford & Billerica Railroad. There are no valid objections to doing so. Those which are urged against it are usually only prejudices, and no difficulty at all has been encountered in running the locomotives in the manner proposed, although on the road named they are run either way that may be most convenient.

There are, however, some important advantages gained in running such engines with their trucks in front or with the chimneys behind.

With the chimney behind and next the car, the smoke and gas from the fire are thrown up above the train, and consequently do not enter the cars so much as they do if the chimney is in front. The reason for this is that the cab, in moving rapidly through the air, creates a partial vacuum behind it, to which the surrounding air has a tendency to flow, and when the chimney is in front the escaping gas and smoke from the top of it are drawn to this vacuum, which is in front of the first car. When the chimney is next the car this does not occur, or, at least, not to nearly the same degree, because the smoke then escapes behind this rarified air produced by the movement of the cab, and consequently the cars, as it were, run under the escaping gases, which are then drawn towards the partial vacuum formed behind the last car of the train.*

In the next place, the truck being some distance forward of the fire-box, the position of the engineer and fireman is necessarily between the truck and the driving-wheels, which is the steadiest part of the locomotive, and therefore the most comfortable place to ride; and as there is no flexible joint in the frame between the boiler and tank, as between ordinary engines and tenders, the cab can be shut up in cold or stormy weather, affording complete protection to the engineer and fireman. In summer the motion of the locomotive carries the hot air from the boiler *out* of the cab instead of into it, as is the case when the boiler is in front. The cab is thus warmer in winter and cooler in summer. Reversing the position and motion of the boiler necessarily brings them in front of it, and the dome and smoke-stack behind them. This leaves a perfectly unobstructed view of the track in front, and *the smoke and escape steam are behind the engineer, and therefore will not obscure the objects in front of him.*

*This can easily be demonstrated mathematically. Suppose *m n* and *m' n'*, fig. 9, to be a curved track, and *g o* a radius of the curve, and *a b* and *c d* two pairs of wheels and axles—the latter parallel to and equidistant from the radius *g o*. Now, in order that the wheels *a* and *c* may run on the same right line or track, they must be in the same plane to which the axles would be perpendicular. If, therefore, from *a*, the point of contact of the wheel with the track, a line, *a c*, be drawn perpendicular to *a b*, this line will be in the plane of the two wheels, and be perpendicular to their axes and to *g o*. From *a* and *c* draw the radii *a o* and *c o*, and at *a* draw a line, *h e*, tangent to the curve *m n*, and therefore perpendicular to the radius *a o*. Now, as the circumference of a circle is perpendicular to its own radii at the point where they intersect, therefore the tangent *h e* and the curve must coincide at the point *a*, and therefore the angle which the line *a c*, lying in the plane of the wheel, makes with the tangent *h e* must be the same angle that the wheel makes with the curved track.

Now, in the triangle *a f o* the angle *a f o* is a right angle, therefore the angle *o a f* + *f o a* = a right angle. But as the angles *o a f* + *f a e* = *e a o*, which is also a right angle, therefore *f a e* must be equal to *f o a*. This latter angle is measured by the arc *a g*, which is one-half the arc subtended by the chord *a c*, which equals the distance between the axles; and as the length of an arc increases with the length of its chord, therefore the greater the distance between the axles the greater will be the angle *f o a* and *f a e*, which is the angle of the wheel to the rail.

* Mr. Mansfield, the General Manager of the Bedford & Billerica Railroad, writes: "We find that our smoke-stacks being near to the car, there is no vacuum, and all cinders are thrown over the train, so the passengers receive none."

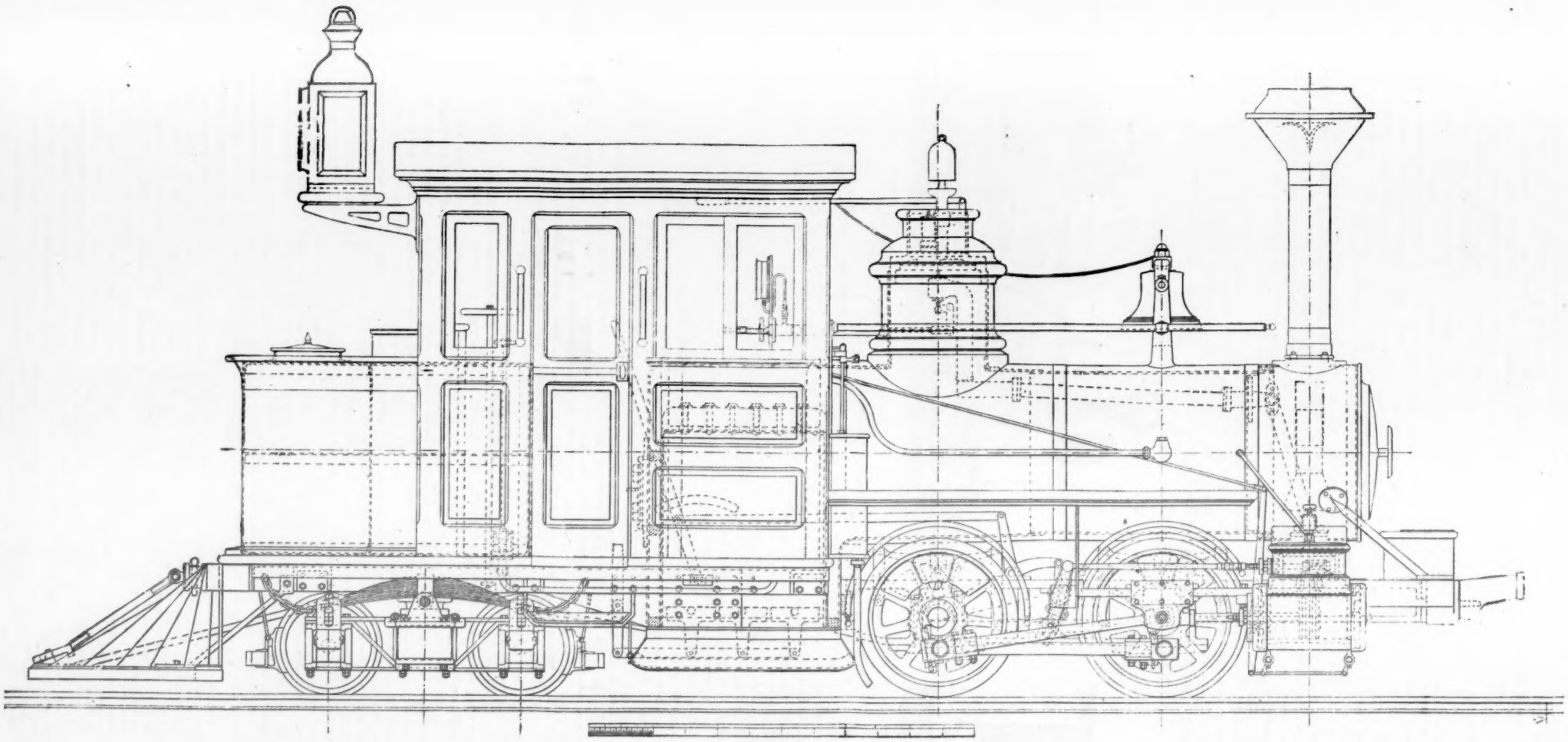

Fig. 12.

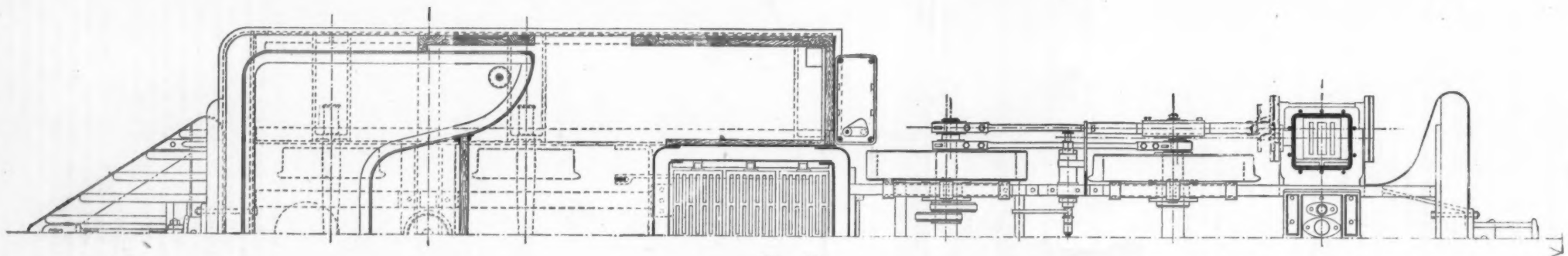

Fig. 13.

Tank Locomotive for the Billerica & Bedford (2 ft. Gauge) Railroad.

By the HINKLEY LOCOMOTIVE WORKS, Boston.

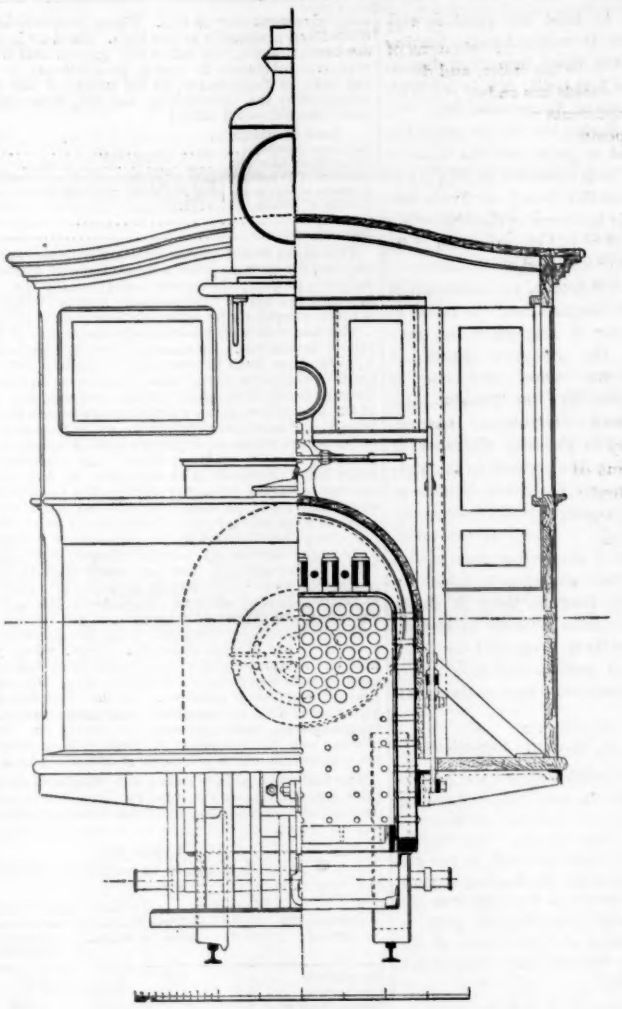

Fig. 14.

Elevation of Front End of Locomotive. Section Through Fire-Box.

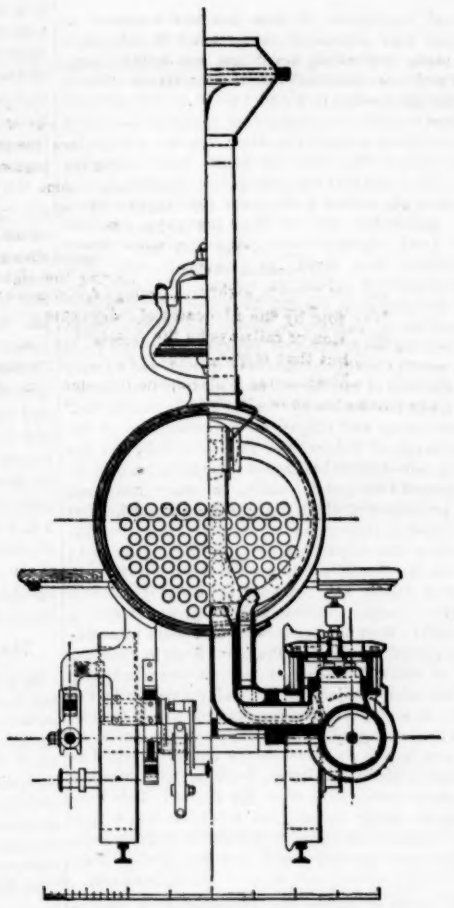

Fig. 15.

Section Through Guide Bar. Section Through Centre of Cylinder and Smoke-Box.

The following are the principal dimensions of these engines:

Gauge of road	2 ft.
Diameter of cylinders	8 inches
Stroke of pistons	12 "
Diameter of driving-wheels	30 "
Total wheel-base	13 ft. 0 in.
Driving-wheel base	3 " 6 "
Weight of engine with fuel and water	23,750 lbs.
Weight on driving-wheels	14,350 "
" " truck	9,400 "
Capacity of tank	400 galls
Inside diameter of front end of boiler	30 in.
Diameter of dome	18 "
Length of fire-box inside	30 "
Width " " " "	27¾ "
Height " " " "	37 "
Water space	2½ "
Number of tubes	70
Diameter " "	1¾ "
Length " "	6 ft. 7 "
Thickness of iron plates in shell of boiler	5-16 "
" " steel " sides and back of fire-box	¼ "
Thickness of steel tube-sheet	⅝ "
" " " crown "	½ "
Size of steam ports	6× ¾ "
" " exhaust "	6×1¾ "

The driving-wheel tires to be of steel, the main pair to be flat or without flanges and 5¼ in. wide, the other pair to have flanges and to be 5 in. wide.

Thickness of tires	2 in.
Diameter of wheel centres	26 "

Size of journals, 4 in. diameter × 4 in. long.

Truck frame to be of wrought iron forged solid, the jaws of cast iron.

Diameter of chilled cast-iron truck wheels, 18 in.

Truck axles to have outside journal-bearings 5 in. long × 2⅝ in. diameter.

Engine to have one No. 3 and one No. 4 Mack's injectors.

A feature in these engines which is worthy of notice is the width of fire-box. With the ordinary methods of construction employed in this country, the fire-boxes on all engines, but especially on those for narrow-gauge roads, must be very much contracted. If the usual plans were followed in engines for a 2 ft. gauge road, the fire-boxes would necessarily be contracted still more than on a 3 ft. gauge road. For this reason, in designing these engines, the method of construction was adopted which is shown clearly in the plan, fig. 13. It will be seen that the wheels are placed entirely beyond the fire-box, so that it can be spread out as wide as may be desired, and the frames are then abutted against the fire-box and attached to it with an expansion joint, so as to allow the boiler sufficient room for the movement which is due to expansion and contraction from heating and cooling. The frames which support the tank and which rest on the truck, consist of flat plates strengthened with angle iron, and are bolted to the sides of the fire-box. This method of construction is admissable for an engine of so small a size, but it need not be resorted to for engines of a much larger size for the standard gauge. It will be seen, however, that it gives all the width of fire-box that is needed, an advantage which, it has been claimed, can only be realized on narrow-gauge roads by the use of the double-truck engines.

Of the working of these engines, Mr. Mansfield, the General Manager of the Billerica & Bedford road, wrote Sept. 9, some time after they were received:

"Everything is working splendid on the road, and the Forney engine is a complete success with us and is admired by every one. They are beginning to see its true principles, if it does run backwards, as they call it. The engineers like it better every day.'

On Oct. 22, he writes:

"The new engines on the 24 in. gauge are a double success. They pass the curves of the Y, 127 ft. radius, with ease. The engineers say they are the smartest and most perfect engine in everything they ever pulled the throttle on. They make more steam than is wanted and use but little coal. We have been burning hard coal the past week, and have made a speed of thirty-five miles per hour on our rough track. The side oscillation are done away with entirely. We ran passenger trains four days last week with the greatest satisfaction, the cars riding smoothly and with perfect ease and no side oscillations, which is noticed by all who speak of it. We have never had any hot boxes on any of the cars since running, or on the locomotives. As to economy, see the following:

"Last week we ran a train 72 miles each day at a cost of 13 cts. per mile. This includes all help, fuel, oil and waste, using less than ¾ ton of coal.*

"The weight of train including engine was 23¼ tons, the weight of cars 11⅛ tons, with seating capacity for 100 passengers, which number we carried on some trips. One of the cars was a combination baggage and express car. There is one grade of 158 ft. per mile, two of 100 ft. one-half mile each long, and numerous other grades of 40 to 90 feet.

"The cost on the Middlesex Central Railroad which we feed into at Bedford, is 60 cents per mile,† and it has only one grade of 60 ft."

On Nov. 28, he writes:

"The Forney locomotive running with the truck in front and the smoke-stack next to the cars does not throw any cinders or smoke on the face or sides of the cars, the smoke and cinders, being carried with the current of air above the train, are thrown behind it, thus giving no annoyance to passengers. We consider this plan of locomotive the best type for one which must combine power and speed with stability, so necessary to overcome steep grades and sharp curves. On our experimental trip in the two-feet gauge road they have pulled three passenger and one box car up a grade of 164 ft. to a mile at a speed of about 18 miles per hour with apparent ease. We believe them to be able to do much better yet. They enter our sharpest curves (of 165 ft. radius) so easily that the change of motion is hardly felt on the foot-board.'

A careful examination of the engravings will show how skillfully these engines have been designed, and the above letters indicate that they work with entire success.

Next week we will give illustrations of the cars used on the Billerica & Bedford road.

*This would be at the rate of about 100 miles per ton of coal.

† The Middlesex Central road is of 4 ft. 8½ in. gauge with the ordinary rolling stock.

Contributions.

"Merchants as Engineers."

TO THE EDITOR OF THE RAILROAD GAZETTE:

In the last number of your valued journal a leading article under the above caption vigorously discussed the well recognized business principle that men should stick to their profession. With your premises and argument most men will agree, but in their application to myself and gentlemen with whom I am associated you make statements which will hardly bear analysis and assertions which only infallibility itself in engineering can justify. The little tract to which the article alluded was one of a series calculated to set men thinking and talking, one of the objects of the Board of Trade and Transportation being to furnish inventors and others opportunities to give publicity to plans and projects, the engineering features of which, however, the board does not pretend to vouch for.

In view of the fact, however, that the most valuable inventions and improvements have from time immemorial met with the strongest opposition from men eminently qualified to judge of their merits, it does not seem to me entirely discouraging when a new proposition is condemned by talented professional men. By this I do not mean to convey the idea that every theory should be swallowed; but simply that chaff must be winnowed to get at the wheat. While the standing and position of the Editors of the *Railroad Gazette* entitle them to become censors in matters pertaining to their profession, they cannot afford to be either radical or unfair towards others who may entertain different opinions.

In regard to the question of gauge, in which you seem to advocate the "Standard" for all purposes and sections, it is evident to me that when such engineers as Mr. W. Milnor Roberts can see good features in the narrow gauge there are two sides to the question and each with good arguments. In your issue of Dec. 14, you state, or leave it to be inferred, that cars and engines can be and are so built as not to weigh or cost any more for one gauge than the other; now this may be literally true but to my unprofessional mind the question suggests itself, would not the axles on a broad-gauge car have to contain more weight of metal to sustain a given load than those of a narrow gauge? This may not be an important difference, and I have no doubt that the above assertion is substantially true, but the question remains to be discussed which guage is best adapted and what rolling stock will prove most economical and durable for a certain kind and amount of traffic. Your allusion to the petition of the Bombay Chamber of Commerce asking that the Indian Government change the gauge of a projected road from a metre to 5 ft. 6 in. may be due to the fact that the great famine in India has concentrated an unusually heavy grain traffic upon roads which are usually not thus taxed; and as the Government sustains the cost of construction, the merchants would undoubtedly prefer a road of the larger capacity, even if it were run at a loss. Ask them to furnish the capital to construct it, however, and they might choose the metre gauge. This will perhaps coincide with your opinion that merchants are both unpractical and selfish. I was in India last year, and found, notwithstanding the 5 ft. 6 in. gauge had the advantage of priority of date, the larger part of the new and projected roads were of the metre gauge. The following extract, which I clipped from the Ceylon *Observer*, shows the opinion of an Indian correspondent:

"We left Tuticorin at 11 a. m., by the new metre gauge railway, and between you and me, depend upon it, that should have been our Ceylon gauge from the first. It would have been quite adequate to our requirements, and would have cost a third less to construct."

But as you advocate the application of the "cold water and

a pump" argument to the advocates of the narrow gauge, I am afraid of unduly exasperating you, and will, therefore, drop this subject, and briefly allude to the legislative regulation of railways, which you refer to as quite "vague and unpracticable."

The general conclusions of your article, "Merchants as Engineers," are that merchants should mind their business of "buying cheap and selling dear" and not trouble themselves about problems connected with transportation. This is precisely what all merchants would like to do, but unfortunately they find that the two interests are so closely associated that one cannot thrive without the other; that the transportation interest controls the other and insists upon taking the lion's share. They find that the great power of steam applied to transportation has within a few years revolutionized commerce, has superseded our old-time highways, and that with these great changes have come certain abuses which merchants are taxed to support; and they naturally organize and agitate for reform. They do not accomplish all that they wish, but they do accomplish something. When the question of legislatures having the right to regulate our modern highways was first agitated some four years ago, the Dartmouth College decision was quoted, and we were told by the advocates of railway interests not only that regulation of railways by the State was "vague and impracticable," but that it was wrong and illegal; the Supreme Court of the United States has since decided the reverse of this, and the moral effect of this decision has caused a modification of railway policy toward the public which, in many instances, has removed grievances of which the public complained. The difference between a railway and a manufacturing corporation, which was at first disputed, is now generally recognized; the one is given no special privileges and is sensitively subject to the law of supply and demand; the other is endowed with the right of eminent domain and to a great extent is a natural monopoly. Most privileges carry with them some duties in the interest of the public. President Scott has become an advocate of national protection for inter-state railways, and he certainly cannot object to national regulation in the same interest. It is only fair that corporations should be conducted with a proper regard for the rights of the public as well as their own, and as corporations are chiefly supposed to concern themselves about the latter, business men who are interested must, perforce, look after the former. This they may not always do wisely or well, but it is to be hoped that the *Railroad Gazette* in criticising their methods will occasionally put on merchants' spectacles and view the question from both sides.

F. B. THURBER.

[When the Board of Trade and Transportation undertakes "to set men to thinking and talking," it is not unreasonable to expect that the thoughts thus prompted should be wise and the conversation profitable. That "the cost of construction of any road can be reduced as the bearing base is narrowed," which is the fundamental principle of the tract referred to, is, we believe, from an engineering point of view, simple folly, and therefore its consideration is not likely to lead to wise thinking or talking.

The fact that valuable improvements and inventions have often been opposed by men apparently qualified to form a correct opinion of their value is a curious defense to urge against the charge which we made that the Board of Trade and Transportation "were giving countenance to the same kind of quackery in engineering that is employed to sell patent medicines." In a similar way the clergyman and others whose names are so often appended to recommendations of various nostrums might excuse themselves by saying that the most efficacious remedies "have from time immemorial" met with the strongest opposition from eminent doctors.

What Mr. Milnor Roberts' opinions of the effect of narrowing the "bearing base" are at the present time we are not able to say, but he is quite competent to speak for himself. It is evident, though, that no reply is possible to the excuse for disseminating an unsound principle, that it is done because some one else believes it to be true.

"That merchants are both unpractical or selfish" was not said and is not believed, any more than of any other class; but we do say that in things they know nothing about they, usually, like other people, are unpractical, and that generally they are quite ignorant of engineering, as the tract referred to indicates.

Buying cheap and selling dear are necessities of commerce, and are not necessarily selfish, and the training which an honorable and successful merchant must acquire is certainly in no way inferior to that of any other occupation; but because a man is a good merchant it does not follow that he is a competent judge of or can direct enginering matters successfully, any more than that such training would qualify him to make astronomical calculations.

That there are many things in railroad management that need reform, there is little room for doubt, and that there are some, in reforming which the efforts of the Board of Trade and Transportation might have a salutary effect, is also probable; but the engineering of railroads is not one of them.

Mr. Thurber seems to disapprove of our prescription of "cold water and a pump" for certain bad cases of "logical inversion," not "narrow-gauge advocates" as he says. He must excuse us for saying that "it does not seem to us entirely discouraging when a new proposition is condemned by talented professional men."

However, we do not mean to treat the question with levity. If the cost of railroads is reduced as the bearing base is narrowed, it is one of the most important discoveries made since railroads were first built; if it is not true, it is one of the greatest delusions of the present day. We believe it to be the latter, and during the last six years the *Railroad Gazette* has endeavored to point out the fallacies of the arguments which have been advanced in support of that proposition. It is because the Board of Trade and Transportation have given their influence in disseminating this error that we have ventured to call the attention of its members to the attitude they had assumed by so doing.

With reference to the Indian railroads, the attention of the "Committee on Railway Transportation" is called to an article in the London *Engineer* of Aug. 10 of last year which was republished in the *Railroad Gazette* of Aug. 24. *The Engineer* is the eldest and one of the ablest engineering papers in the world, and has heretofore been an earnest advocate of narrow-gauge doctrines. It says: "The Bombay Chamber of Commerce has sent a memorial on the subject to the Marquis of Salisbury. It is a temperately-written document, and its indictment of the narrow-gauge system *is sweeping, and to a great extent conclusive.* * * There is too much reason to think that *the failure of the narrow-gauge system in Hindostan is complete.*" These statements, taken in connection with the fact that the Toronto, Grey & Bruce 3 ft. 6 in. gauge road is trying to raise $900,000 to change its gauge to 4 ft. 8½ in., can hardly be regarded as alone the "condemnation of talented professional men": they are the results of abundant experience.—EDITOR RAILROAD GAZETTE.]

The Comparative Values of Modern Explosives.

By permission of the author and publishers, we are permitted to make the following selections from the forthcoming work on "Tunneling, Explosives and Rock Drills," by Henry S. Drinker, now in the press of John Wiley & Sons. The character of the work, the thorough investigations made by the author, and the assistance given him by the leading experts strongly recommend what he has to say on this subject to the attention of all who have to use explosives for any purpose. Our selection is given under the head of "Discussion of the Different Explosive Reagents," in Mr. Drinker's Chapter III. "On Modern Explosive Compounds."

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DISCUSSION OF THE DIFFERENT EXPLOSIVE REAGENTS.

And now with regard to the comparative characteristics of the different explosives, it would be rash to lay down any empirical rules as to the one being better or worse than the other.

The question must vary with the character of the material used and with the position in the material (whether heading or bottom) in which the explosive is to be applied, and we can, perhaps, consider the question better after reviewing the principles of blasting in the succeeding chapter. There are, however, some comparative tables of the intrinsic properties of the different compounds (not of results of their application), which may be of interest here.

We have seen, in the discussion of the three principal explosive compounds, what their calculated power is. It may now be well to present these figures in direct contrast:

TABLE X.

	Powder.	Nitro-glycerine.	Gun Cotton.
Mixture of gases in cubic centimetres at 32° F. (0° C.) produced by 1 gramme of the explosive	200	2,000	1,200
Temperature of these gases in degrees centigrade	3,300	5,300	4,500
Theoretical maximum pressure in atmospheres (1 kilogramme to 1 square centimetre)	4,300	26,000	15,300
Theoretical maximum power per kilogramme of explosive in kilogrammetres	42,000	400,000	200,000
Theoretical maximum power per kilogramme of explosive in foot-pounds	303,786	2,893,200	1,446,600

Now, from this, it would appear that the theoretical maximum pressure of nitro-glycerine is six times, but the theoretical maximum power ten times that of gunpowder. Berthelot has calculated the quantity of heat generated in the explosive reaction of different bodies, and the volume of gas formed—the product of these numbers giving a term of comparison between the pressure that, as he conceives, "accords in general with experience."

TABLE XI.

Explosive Substances.	Quantity of Heat evolved per kilo.	Volume of Gas formed.	Product of the two preceding Numbers.
	cal.	m. c.	
Blasting powder	510,000	0.173	88,000
Chloride of nitrogen	316,000	0.370	117,000
Artillery powder	608,000	0.225	137,000
Sporting powder	641,000	0.216	139,000
Nitrate of soda powder	764,000	0.248	190,000
Picrate of potash and saltpetre	852,000	0.337	286,000
Chlorate of potash powder	972,000	0.318	309,000
Picrate of potash	578,000	0.585	337,000
Picric acid and saltpetre	923,000	0.408	376,000
Gun-cotton	590,000	0.801	472,000
Picrate of potash and chlorate of potash	1,422,000	0.337	478,000
Nitrated gun-cotton	989,000	0.484	480,000
Picric acid	687,000	0.780	536,000
Picric acid and chlorate of potash	1,424,000	0.408	582,000
Chlorated gun-cotton	1,420,000	0.484	680,000
Nitro-glycerine	1,320,000	0.710	939,000

These figures are given both by Trautzl and Schoen.

By this table it would appear that, theoretically, sporting powder, though giving out more heat than either blasting or cannon powder, is still not much stronger. Again, blasting powder is one of the lowest of explosives. The ratio of gun-cotton to blasting powder is, theoretically, over 5 to 1, and that of pure nitro-glycerene over 10 to 1. These proportions, however, are considered practically as too high. Sarrau,* in some more recent experiments, has taken the ground that the force of any explosive substance is nearly proportional to the product of the heat of combustion, by the weight of the permanent gas produced by the combustion, and has, from experiments, prepared the following table:

Name of substance.	Relative force
Saltpetre powder	1
Chloride of nitrogen	1.06
Mixture of 55 parts picrate of potash and 45 parts saltpetre	1 49
Mixture of equal weights of picrate and chlorate of potash	1.82
Picrate of potash	1.96
Gun-cotton	3.66
Nitro-glycerine	4.55

This again would appear practically to be too low a ratio to express, for instance, the relative force of nitro-glycerine and saltpetre powder; the reason is that, under the circumstances in which the higher explosives are now used, their full strength is more completely brought out than that of powder.

This has well been shown in the researches of Roux and Sarrau on detonation. To their joint researches is chiefly due the light that has been thrown on the possibility of producing two kinds of explosion in the same substances, and they distinguish them as being of the *first* or of the *second* order. An explosion of the first order occurs when the explosive is fired by the application of heat and percussion; an explosion of the second order occurs when the explosive is fired simply by the application of heat, as in applying flame. An explosion of the first order being produced in an explosion by the detonation of a substance having primarily that quality (as fulminate of mercury) may itself be called a "detonation," as contradistinguished from an explosion of the second order, which is what has always been known by the simple term "explosion."

As to the detonating powders proper, Sprengel remarks:† "It is to be regretted that no exact method exists for comparing the force of detonating explosives." How a detonating substance directly affects a sympathetic detonation in another explosive, not primarily detonable, is not yet determined.

Detonation may be defined to be the instantaneous explosion of the whole mass of a body. Thus, when gunpowder is fired in the usual manner, true combustion takes place, which goes on with comparative slowness from the surfaces of the grains toward their interiors. On the other hand, when nitro-glycerine is fired by means of fulminating mercury, the whole mass explodes simultaneously or nearly so. Ordinary gunpowder can be detonated if fired with a small amount of nitro-glycerine which primarily is detonated by a fulminate.

The following table‡ shows the results of Roux's and Sarrau's experiments on the relative force developed by the simple explosion and detonation of the three prominent explosives:

TABLE XII.

RELATIVE STRENGTH OF EXPLOSIVE COMPOUNDS.

Substance Exploded.	Simple Explosion.	Detonation.	Relative weight of Gases.	Heat disengaged by 1 lb.	
				Simple Explosion.	Detonation.
Gunpowder	1.00	4.34	0.414	1,316	1,318
Gun cotton	3.00	6.46	0.850	1,902	1,909
Nitro-glycerine	4.80	10.13	0.800	3,097	3,200

Now, this table shows most emphatically the enormous increase of force gained by detonation over explosions; for ordinary gunpowder is seen to be raised at once to over four times its explosive strength. It must further be remembered that in practice gun-cotton and nitro-glycerine are detonated in blasting, while black powder is not. Practically, nitro-glycerine can therefore (Hill) be said to be about eight times as powerful as black powder, dynamite (75 per cent. nitro-glycerine) six times, and gun-cotton from four to six.

Curtis and Harvey have recently produced in England a variety of gunpowder (known as E. S. M.), which, owing to its possessing the quality of quicker ignition, has been found (according to Andre) to be susceptible of direct detonation, and has, on detonation, developed an enormous increase of force; greater than the relative amount found for gunpowder in Roux and Sarrau's experiments, and, in fact, little if at all inferior to dynamite, with a percentage of 75 parts of nitro-glycerine. (This would in a measure explain the force developed by the dope of No. 2 dynamite, if the latter is considered to be detonated.) Now, this discussion leads directly to the conclusion so ably put by Andre, that the various explosive compounds, according to their work in blasting, can clearly be divided into the two classes of,

1. Slow or rending compounds.
2. Quick or shattering compounds.

A slow or rending compound is therefore distinctively one in which the transformation of the substance into gaseous form is slow, and where the explosive force is exerted by degrees as the gases are developed; and these compounds are the ones in which the greatest effect produced is not invariably at the exact point at which the explosive is located—*i. e.*, the gas, being slowly evolved, will tend to concentrate its strength and act in the line of least resistance, and the pressure upon the containing body can in no part be greater than that which is exerted on the part which yields—*i. e.*, it can never be greater than the resistance of the least resistant part. This class of explosives is, of course, especially applicable in quarries, etc., where the material is required to be blasted in certain shape or in large blocks. Gunpowder is its prominent type.

A quick or shattering compound is, on the other hand, one where the transformation of the substance into gas occurs practically instantaneously, and the full force of the enlarged volume is at once exerted in all directions and upon every part of the containing body, because motion requires time, and as no time is allowed for the less resistant part to yield, by moving away before the pressure of the fluid, it follows that the whole force of the latter must be exerted upon all alike; the rock is therefore not only blown out in fragments to the full depth of the hole, but is violently strained and shattered in the immediate vicinity of the hole, even where the resistance is greatest; so we see that these shattering explosives are of course of especial value in tight headings driven through hard rocks. Of this class, nitro-glycerine is the distinctive type.

Between gunpowder and nitro-glycerine as extremes, the other explosives in use range according to their strength; and we must remember, in studying their practical application to blasting, that, in choosing the best explosive for a particular piece of work, and in different parts of the same work, many circumstances must be taken into consideration: whether the material to be blasted is homogeneous in its character, whether it be a hard, soft, or loose rock, and whether time (as in most railroad tunnels) is an essential element in the problem. In the same piece of work, different explosives can generally be used to advantage, in the different workings, with economy of both time and money; as in a tunnel, the heading often requires a quick and the bottom a lifting force. For this reason, it will not do to assume that one explosive is practically a better one than another, in the ratio in which it may be said to exceed it in power. No general comparison can be made or empirical rule laid down, but good judgment in this as in other engineering problems must be exercised.

* "Recherches Theoretiques sur les Effets de la Poudre et des Substances Explosives."

† Journal Chemical Society, I., p. 302.

‡ Andre on Coal-Mining, p. 307.

ANNUAL REPORTS.

Charlotte, Columbia & Augusta.

This company owns a line 195 miles long, from Charlotte, N. C., southward to Columbia, S. C., and thence southwest to Augusta, Ga. Its latest report is for the year ending Sept. 30, 1877.

The equipment consists of 23 locomotives; 9 first and 8 second-class passenger, and 9 baggage, mail and express cars; 142 box, 12 stock, 55 flat and 10 cab cars. One engine was broken up during the year.

The balance sheet at the close of the year was as follows:

Stock ($13,221 per mile)		$2,578,000 00
Bonds ($12,875 per mile)		2,510,547 62
Bills and accounts payable		116,473 35
Profit and loss		311,118 48
Total ($28,288 per mile)		$5,516,139 45
Road and equipment ($26,315 per mile)	$5,131,364 33	
Real estate	61,334 59	
Bonds and stocks	175,809 37	
Materials, iron rails, etc	51,304 99	
Cash, bills and accounts receivable	96,326 17	
		5,516,139 45

The bonded debt consists of $2,000,000 first and $500,000 second-mortgage bonds, $10,000 old Charlotte & South Carolina bonds, and $547.62 fractional bonds.

The work done was as follows:

	1876–77.	1875–76	Inc. or Dec.	P.c.
Freight engine mileage	159,887	.....	.....	....
Passenger " "	151,067	170,486	Dec..19,419	11.4
Service and switching	60,574	.....	.....	....
Total	371,528	402,247	Dec..30,719	7.6
Cost of engine service per mile.	13.65 cts.	.....	.....	....
Passengers carried	57,720	60,880	Dec.. 3,160	5.2
Tons freight carried	99,192	99,139	Inc.. 53	....
Av. receipt per ton per mile	2.74 cts.	.....	.....	....

The number of through passengers was 13,026. The cotton carried was 132,110 bales of which 3,935 came from connecting roads at Charlotte, 53,532 from connecting roads at Augusta, and 74,643 bales from local stations. The greater part of this cotton, 100,811 bales, was transferred to the Wilmington, Columbia & Augusta at Columbia.

The earnings for the year were as follows:

	1876–77.	1875–76.	Inc. or Dec.	P. c.
Passengers	$153,760 37	$163,185 82	Dec.$9,425 45	5.8
Freight	284,216 27	298,598 62	Dec. 14,382 35	4.8
Mails and express	26,002 05	62,778 22	Dec. 3,597 94	5.7
Minor sources	33,179 23			
Total	$497,156 92	$524,562 66	Dec.$27,405 74	5.2
Expenses	294,668 14	321,235 00	Dec. 26,566 86	8.3
Net earnings	$202,488 78	$203,327 66	Dec. $838 88	0.4
Gross earn. per mile	2,549 52	2,690 03	Dec. 140 54	5.2
Net " " "	1,038 40	1,042 71	Dec. 4 31	0.4
Per cent of expenses	59.27	61.24	Dec.	1.97 3.2

The current or income account for the year was as follows:

Cash, materials and balances due Oct. 1, 1876		$152,912 69
Earnings for the year		497,156 92
Accounts and bills payable increased		8,114 92
Pay-rolls and balances payable		15,908 02
Total		$674,092 55
Balances due other roads, etc., Oct. 1, 1876	$25,366 72	
Working expenses	294,668 14	
Taxes paid during the year	20,855 79	
Coupons paid	174,492 50	
Other interest, city of Augusta, etc	23 408 53	
Materials, fuel and iron rails	26,851 54	
Due from companies and others	22 491 59	
Paid balance on last year's pay-roll	12,101 42	
Cash and balances due	73,826 82	
		674,092 55

The earnings from through business showed a considerable increase, which was, however, over-balanced by the decrease in local earnings.

During the year 300 tons iron and 1,000 tons of steel rails were laid; 89,138 new ties and 4,091 stringers were used. Several miles of iron T rails replaced by steel were used to replace old "chub" rail on the Charlotte Division. The passenger equipment was fitted with the Westinghouse brake. Several new station buildings were erected, and a new cotton platform built at Augusta.

The expenses have been reduced, in spite of the necessity of running passenger trains at a higher speed in order to keep up the same time as competing lines. The receipts have been reduced by low rates, and some business has been diverted by the opening of the Chester & Lenoir road and its connection with the Air Line near Charlotte.

The Wilmington, Columbia & Augusta business at Columbia has been transferred to the depot of this company, effecting a considerable saving in transfer expenses. The Wilmington company built the necessary connecting line.

Boston & Lowell.

This company owns and leases the following lines:

	Miles.
Main Line, Boston to Lowell, double track	26.75
Mystic River Branch	2.25
Lexington & Arlington Branch	9.25
Woburn Branch	2.00
Stoneham Branch	2.50
Lawrence Branch	3.21
Total owned	45.96
Lowell & Lawrence R. R., leased	13.00
Salem & Lowell R. R., leased	16.00
Middlesex Central R. R.	7.98
	36.98
Total	82.94

The whole system and that of the Nashua & Lowell Company are worked together under one management, the earnings and expenses being divided in the proportion of 69 per cent. to the Boston & Lowell, and 31 per cent. to the Nashua & Lowell. The report is for the year ending Sept. 30, 1877.

The general account, condensed, is as follows:

Stock ($70,714 per mile)		$3,250,000 00
Bonds ($46,225 per mile)		2,124,500 00
Notes payable		407,000 00
Lowell & Lawrence and Salem & Lowell roads		77,527 50
Unpaid coupons and coupons due Oct. 1, 1877		48,420 36
Profit and loss		491,776 24
Total ($139,235 per mile)		$6,399,224 10
Construction and equipment ($108,369 per mile)	$4,980,656 35	
Leased line equipments	51,984 60	
East Cambridge property and Mystic River wharf	490,731 15	
Leased line stocks	345,674 00	
Nashua & Lowell accounts	153,212 59	
Sinking and insurance funds	198,089 30	
Cash and materials on hand	178,876 41	
		6,399,224 10

During the year $264,000 of the 6 per cent. bonds of 1876 were sold, and the amount of notes payable was decreased by $347,000. Construction account was increased $19,597.04 for the East Boston bridge and some station improvements; East Cambridge property by $925.69 for land bought, and Mystic River wharf by $19,531.84, for improvements made, an addition of $40,054.57 in all.

The earnings for the year were as follows:

	1876–77.	1875–76.	Inc. or Dec.	P. c.
Passengers	$506,967 56	$505,961 74	Inc . $1,005 82	0.2
Freight	587,916 42	576,311 34	Inc.. 11,605 08	2.0
Mail and express	31,477 73	32,227 95	Dec . 750 22	2.3
Accumulation of sinking funds	11,407 78	13,390 00	Dec.. 1,982 22	14.8
Total	$1,137,769 49	$1,127,891 03	Dec.. $9,878 46	0.9
Expenses and taxes	789,762 28	812,030 17	Dec.. 22,267 89	2.7
Net earnings	$348,007 21	$315,860 86	Inc..$32,146 35	10.2
Gross earn. per m.	13,717 99	13,598 88	Dec.. 119 11	0.9
Net " "	4,195 89	3,808 31	Inc.. 387 58	10.1
Per cent. of exp'es	69.41	72.09	Dec.. 2.59	3.6

The net results of the year were as follows:

Net earnings		$348,007 21
Rents	$93,308 61	
Interest	121,223 31	
Adjustment of balances, Northern R. R.	24,667 50	
		239,199 42
Surplus for the year		$108,207 79

Out of this surplus a dividend of $10 per share (2 per cent.) has been declared since the close of the year. Although the property has been maintained in good condition, it was considered best not to divide the whole of the surplus, but to retain a part to provide for emergencies.

The traffic of the year was as follows:

	1876–77.	1875–76.	Inc'se.	P. c.
Passenger train mileage	527,938	526,535	1,403	0.3
Freight train mileage	411,869	395,486	16,383	4.1
Total	939,807	922,021	17,786	1.0
Passengers carried	1,941,787	1,929,516	12,271	0.6
Tons freight carried	568,430	555,510	12,920	2.3

Very low rates on all the through-line business have prevailed throughout the year. New contracts were concluded with the New Hampshire roads, and old differences were adjusted, so that the relations with those roads are now satisfactory. Active efforts are being made to settle the differences relating to the Central Vermont and Western line business, with some prospect of success.

The lease of the Lowell & Lawrence road has been renewed with some changes. That road is now being extended to a more central point in the city of Lawrence, where better facilities for freight and passenger business can be had than at the old terminus.

The freight bridge over Charles River has been widened so as to lay four tracks to within 415 feet of the East Cambridge shore. Permission to widen the rest of the bridge has been asked. Several improvements have been made at the Mystic Wharf and a transfer grain elevator has been completed. About 850 feet of the pier have been constructed. The approaches to the wharf have been bettered by the filling in of Chelsea Bridge by the city of Boston.

The contract with the Nashua & Lowell will expire Oct. 1, 1878, and the board asks for authority to make a new contract or lease. The report treats of this subject at considerable length, and acknowledges the benefits resulting from the joint working of the two roads, the board, however, considering that the Nashua & Lowell now receives too large a share of the joint earnings.

Reference is made to the death, last May, of Hon. Francis B. Crowninshield, who was President of the company for 22 years.

New York, Providence & Boston.

This company owns and works a line from Providence, R. I., to Groton, Conn., 62½ miles; there are 50 miles of second track and 7¾ miles of sidings. There are several short branches worked in connection with the road, but they have been built by separate organizations and their accounts are kept separately. The company operates a steam ferry between Groton and New London, and owns a controlling interest in the Providence & Stonington Steamship Company, whose lines run from Stonington and Providence to New York. The report is for the year ending Sept. 30, 1877.

The road is equipped with 26 engines; 31 passenger and 9 baggage cars; 111 box and 112 flat cars, and 16 gravel cars. The passenger equipment is fitted with the Miller platform and coupler and the Westinghouse air brake.

The liabilities of the company, as given, are:

Stock ($48,000 per mile)		$3,000,000
Bonds ($18,608 per mile)		1,163,000
Total ($66,608 per mile)		$4,163,000

There has been no change in these amounts during the year. The annual interest charge is $78,150, or $1,250.40 per mile of road. The company owns interests in several branch lines, and $804,900 out of a total of $1,260,000 stock of the Providence & Stonington & Steamship Company.

The work done was as follows:

	1876–77. (12 m'ths.)	1875–76. (13 m'ths.)	Inc. or Dec.	P.c.
Train mileage, passenger	278,311	370,119	Dec,. 91,808	24.5
" " freight	165,639	180,511	Dec.. 14,872	8.2
" " other	103,290	57,720	Inc.. 45,570	79.0
Total	547,240	608,350	Dec.. 61,110	10.0
Pass'ng'rs carried, through	147,337	188,875	Dec.. 41,508	22.0
" " local	446,306	580,889	Dec.. 134,583	23.2
Total	593,673	769,764	Dec.. 176,091	22.9
Passenger mileage	15,378,852	19,570,190	Dec..4,191,338	21.4
Tons freight, through	187,162	201,344	Dec.. 14,182	7.0
" " local	60,414	70,563	Dec. 10,149	14.4
Total	247,576	271,907	Dec.. 24,331	8 9
Tonnage mileage	9,222,206	10,128,540	Dec.. 906,334	8.9
Av. pass. train load, No.	55.26	52.88	Inc.. 2.38	4.5
Av. freight train load, tons.	55.68	56.11	Dec.. 0.43	0.8
Rate per pass. per mile, excluding season tickets	2.65 cts.	.....	.....	....
Rate per pass. per mile, all passengers	2.40 cts.	.....	.....	....

These comparisons are not strictly correct, however, the year 1875–76 including the accounts for 13 months, owing to a change in the fiscal year. The same applies to the earnings of the two years, which were as follows:

	1876–77. (12 months.)	1875–76. (13 months.)	Inc. or Dec.	P. c.
Passengers	$380,486 44	$516,272 43	Dec..$135,785 99	26.3
Freight	313,351 20	390,743 79	Dec.. 86,392 59	21.6
Mails	8,835 77	10,014 06	Dec.. 1,178 29	11.8
Rents and miscellaneous	30,288 33	26,511 86	Inc.. 3,776 47	14.3
Total road receipts	$732,961 74	$952,542 14	Dec..$219,580 40	23.1
Steamship Co. dividends	120,735 00	112,686 00	Inc.. 8,049 00	7.1
Total	$853,696 74	$1,065,228 14	Dec..$211,531 40	19.9
Expenses	494,699 43	600,026 58	Dec.. 105,327 15	17.6
Net earnings	$358,997 31	$465,201 56	Dec..$106,204 25	22.8
Road earnings per mile	11,727 39	15,240 67	Dec.. 3,513 28	23.1
Net earn. per mile	5,743 96	7,443 22	Dec.. 1,699 26	22.8
Per cent. of expenses to road earnings	67.49	62.99	Inc.. 4.50	7.1

The report says: "A proper comparison of the figures presented in the foregoing statement with the corresponding period of the previous year, requires that the business of the month of September, 1875, should be deducted from the gross earnings and expenses for 1876, as stated in the last annual report. On this basis, the gross receipts show a falling off of $122,626.72, viz.: on passengers, $87,880.74; on freight, $50,089.61; making a total of $137,970.35, the discrepancy of $15,343.63 being made up by increased dividends and rents received from the P. & S. S. Co. Comparing, on the same basis, the expenses, we find a decrease for the year of $53,000, and in the net earnings a total decrease of about $70,000—a result not so satisfactory as could be desired, but, in view of all the circumstances, far from discouraging.

"Comparing the amounts paid during the year for dividends and interest with the net earnings, there appears to be a deficiency of $44,000; but of this amount $25,000 was the proportion divided for the month of September, 1876, and charged in this year's account, and nearly $13,000 appears as due and has since been paid by the Steamboat Company. The remaining $6,000 is more than made up by the company's interest in the undivided profits of the P. & S. Steamship Company, of which it owns $804,900 out of the $1,260,000 of stock issued."

The income account for the year is as follows:

Balance cash assets from last report		$113,536 34
Receipts		853,696 74
A. & W. Sprague, balance of loan		88,959 00
Total		$1,056,192 08
Expenses	$494,699 43	
Interest	78,150 00	
Dividends	325,000 00	
Extraordinary expenses, Richmond Switch accident	10,251 68	
Construction account	56,281 45	
Losses, back dividends paid, etc	3,157 97	
	967,540	
Balance cash assets to new account		$88,651 55

The New York and Boston through business has been seriously disturbed by the breaking up of the former agreements as to rates by the withdrawal of the Fall River Line, on account of the establishment of new through lines by the New York & New England, and of the direct steamboat line to Providence. All efforts to arrange matters have thus far failed, and rates are still very low.

A few claims arising from the Richmond Switch accident are still in litigation.

During the year 1,478 tons of new steel rails were laid, making 50½ miles of track now laid with steel. The difference between cost of steel and iron was charged to construction. Over 27,000 new ties were laid and 2,000 rails repaired and relaid. The new ferry slip at New London has been completed and the Groton slip rebuilt and enlarged.

THE SCRAP HEAP.

Railroad Manufactures.

The Mason Machine Works at Taunton, Mass., have an order for five locomotives for the New York & Manhattan Beach Rail road. They will have 12 by 16 in. cylinders and driving wheels 43 in. in diameter.

The New Jersey Steel & Iron Co., at Trenton, N. J., has a contract for part of the superstructure for the new tracks of the New York Elevated Railroad.

The Kansas City, St. Joseph & Council Bluffs and the Atchison & Nebraska companies have each recently had 100 freight cars built, all with the Chalender iron truck.

The contract of the Passaic Rolling Mill Co., of Paterson, N. J., with the New York Elevated road is for about 3,000 tons of iron work for the superstructure of the road, and not 6,000 tons as stated last week.

The Taunton (Mass.) Locomotive Works has a contract for ten engines for the Union Pacific Railroad. They are to be ten-wheeled engines with 18 by 24 in. cylinders.

The bridge over the Potomac River for the Cumberland Valley Railroad, the contract for which has been let to the Delaware Bridge Co., of New York, as we noted last week, will consist of six spans of 146 feet each, for single track. It will replace the wooden bridge carried away by freshets last month. It is near Williamsport, Md., and at the same place where General Lee's army crossed before the battle of Gettysburg.

The Columbia Car Spring Co. has opened a new branch office at No. 109 North Third street, St. Louis. The company reports prospects looking bright for the new year, with large orders coming in from some of the principal roads.

The Chattanooga Iron Co. is making a lot of Bessemer pig from specular ore from its mines at Cartersville, Ga. The iron is to be used in the Roane Iron Co.'s new steel works at Chattanooga.

The Pittsburgh *Telegraph* reports 750 men employed at the Keystone Bridge Works on bridges to replace some destroyed by last month's freshets, and on a contract for one of the new elevated railroads in New York.

The Laclede Rolling Mill, at St. Louis, is running full, with plenty of orders.

The Westerman Iron Works, at Sharon, Pa., have been filling a large order for 1¾ in. round iron of extra quality for car links for a Chicago firm.

The Helmbacher Forge & Rolling Mill Co., at St. Louis, is running its works, with a fair amount of orders on hand.

The blast furnace and rolling mill of Wm. Schall & Sons, at Norristown, Pa., have been sold to J. H. Boone, of Reading.

A correspondent of the *Iron Age* reports that out of 12 furnaces in Marquette County, Mich., in the Lake Superior region, only two are running, the Carp River and Pioneer. The two Bay furnaces, in Schoolcraft County, were recently destroyed by fire. In Delta County the Elk Rapids and one of the Fayette furnaces are in blast. Out of eight furnaces in Northern Wisconsin only three are in blast.

Messrs. Buff & Berger, manufacturers of engineers' instruments in Boston, have just completed an instrument for making and comparing standard rules and measures. The pitch of the micrometer screws, which are 12 and 18 inches long, corresponds to a millimeter. By means of graduated circles and the aid of powerful microscopes, accurate measurements within the 0.001 part of a millimeter can be made readily. To obtain great regularity of pitch and diameter, the screws were cut and finished entirely in a dead-centre lathe and by a somewhat novel process. The instrument was ordered by the University of Michigan, at Ann Arbor, Mich.

It is reported that the Grant Locomotive Works, at Paterson, N. J., have a contract for a number of engines for the Gilbert Elevated Railroad in New York.

Notes.

The people of St. Paul, Davenport and some other towns on the Upper Mississippi have been celebrating New Year's day by steamboat excursions on the river. This is a decided novelty, the oldest inhabitant not being able to remember a New Year's day before when the river was open.

"What makes you walk so strangely?" an inquisitive friend asked a man with an artfully concealed artificial leg. "Oh," replied the disabled railroader, "I've slipped an eccentric and am only working one side."—*Burlington Hawkeye.*

The Denver *Tribune* tells of a Colorado minister who received the customary half-fare ticket and thereupon wrote to the Superintendent asking him if "he could embrace his wife also." Being a cautious man, the Superintendent replied doubtfully, saying that he thought he could, but he would like to see the lady first, as he was a little particular in such matters.

There has been so much rain in southern Iowa this winter that the conductors of the B. & M. freight trains take rank with rear admirals.—*Burlington Hawkeye.*

RAILROAD GAZETTE

Published Every Friday.

CONDUCTED BY

S. WRIGHT DUNNING AND M. N. FORNEY.

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Editorial Announcements.

Passes.—*All persons connected with this paper are forbidden to ask for passes under any circumstances, and we will be thankful to have any act of the kind reported to this office.*

Addresses.—*Business letters should be addressed and drafts made payable to* THE RAILROAD GAZETTE. *Communications for the attention of the Editors should be addressed* EDITOR RAILROAD GAZETTE.

Advertisements.—*We wish it distinctly understood that we will entertain no proposition to publish anything in this journal for pay,* EXCEPT IN THE ADVERTISING COLUMNS. *We give in our editorial columns* OUR OWN *opinions, and those only, and in our news columns present only such matter as we consider interesting and important to our readers. Those who wish to recommend their inventions, machinery, supplies, financial schemes, etc., to our readers can do so fully in our advertising columns, but it is useless to ask us to recommend them editorially, either for money or in consideration of advertising patronage.*

Contributions.—*Subscribers and others will materially assist us in making our news accurate and complete if they will send us early information of events which take place under their observation, such as changes in railroad officers, organizations and changes of companies, the letting, progress and completion of contracts for new works or important improvements of old ones, experiments in the construction of roads and machinery and in their management, particulars as to the business of railroads, and suggestions as to its improvement. Discussions of subjects pertaining to* ALL DEPARTMENTS *of railroad business by men practically acquainted with them are especially desired. Officers will oblige us by forwarding early copies of notices of meetings, elections, appointments, and especially annual reports, some notice of all of which will be published.*

THE MAINTENANCE OF EAST-BOUND RATES.

The prospects for a profitable winter traffic are seriously threatened by the troubles regarding east-bound freight—the great traffic, which this winter promises fair to be unusually large, perhaps greater than ever before; and under circumstances which, with harmony among the railroads companies, render it perfectly practicable to make a large profit out of the business. Business in December, it is true, was not very large on the Western roads; the weather being mild and wet and the mud bottomless, so that farmers could not easily get their produce to the stations; but the arrivals at the seaboard have been fully up to the average, or rather far beyond it, showing that the lines to the West were getting a fair traffic from the stocks accumulated at the great markets, or from some other sources. But for some reason, which does not clearly appear, the competition of roads at Chicago and Mississippi and Missouri River points has resulted in the cutting of rates by some of the companies, in spite of their written agreements last October with each other and with the trunk lines to maintain rates, under penalty of such action by the trunk lines as would make it impossible to carry the traffic except at a loss.

The October agreement of the Western road did not provide for the division of traffic, but simply for the maintenance of agreed rates. If this is a simpler matter than the division of traffic, and one which the companies more readily consent to, it is much more difficult to effect. The fact is, railroad companies will not maintain rates if they are losing their business, and apparently their only way to be sure of maintaining rates is to guarantee business to the several lines, and, further, prevent their profiting by any diversion of traffic from their neighbors.

As we have said, however, nothing of the kind was arrived at under the October agreement. This was something more, however, than the usual exchange of promises to maintain rates. The something more was the attachment of a penalty for the violation of the agreement. On all through traffic from most competitive points as far west at the least as the Mississippi, and as far north as Chicago and Burlington, Iowa, the roads "pro-rate." That is, each line over which freight passes receives a proportion of the total charge equal to its proportion of the total distance from point of shipment to destination. Thus if the distance were 1,000 miles, and the shipment passed 440 miles over an Eastern trunk line, 500 miles over an intermediate road, and 60 over the Western receiving road, the latter would get 0.06 of the freight charge, the intermediate road 0.50, and the trunk line 0.44.

Sometimes the Western road is allowed a "constructive mileage," more or less in excess of its actual mileage; but the method of division remains the same, and also the effect of a refusal to "pro-rate."

Now the practice is, and has nearly always been, for the road which receives the freight to make the rate. The Pennsylvania, the Erie and the New York Central establish the rates from New York to Chicago, and their connections take their proportion of it, whatever it may be, whether 20 cents or a dollar per 100 lbs., without question. On the other hand, the Michigan Central, the Lake Shore & Michigan Southern, the Baltimore & Ohio and the Pittsburgh, Fort Wayne & Chicago make the rates from Chicago to New York, and their Eastern connections have nothing to say except to claim their share. The agents on the ground are supposed to understand best the exigencies of the situation. It is necessary to come to a decision promptly, without waiting for consultation with distant connections, and there seems to have been no question as to the propriety of this general policy.

But, it is easy to see, this leaves a company without any direct voice as to the price for which it will carry perhaps its largest traffic. It becomes an ally which may and frequently is employed in fighting other people's battles with parties against whom it has no grievance. The Pennsylvania and the Baltimore & Ohio quarrel, and the result is that the Ohio & Mississippi and the Indianapolis & St. Louis carry at a loss. Because the two trunk lines could not agree, these two Western roads, three hundred miles off, lose perhaps one or two hundred thousand dollars from a year's profits.

And it is easy to see that if the connecting roads did not "pro-rate," the reductions of rates in railroad wars would be greatly limited. For instance, the charge on first-class freight from New York to Chicago has sometimes been reduced from $1 to 25 cents per 100 lbs. by the breaking out of a railroad war. But suppose the western connections of the trunk lines should claim their proportion of the old rate, in spite of the contest. That proportion would be about 54 cents, and the competition would be practically limited to the roads having termini at the places where the competitive traffic originated. They could make reductions on their own 46 cents of the rate, but nothing further.

Now it is not practicable to make it a general rule that the road receiving the freight shall be limited to its own share of the rate in making reductions in consequence of competition. In that case the road with the shorter line would be helpless; and, as all sections of a line are usually (not always) interested in the competition, and promptness is indispensable in such competition, it has seemed practically indispensable to make the receiving road the agent of all the other roads in the line, with full powers.

The limitation placed upon this by the October agreement is, virtually, that while the trunk lines will be bound by any action of their connections acting together, or in accordance with an agreement of such western lines, they will refuse to accept freight on this basis from a connection which breaks the agreement of the western roads and accepts less than the regular rates. On application by the Executive Committee of the Western companies the trunk lines agree to charge their regular local rates on freight received from such a connection. This local rate is not its proportion of the regular through rate, but a larger amount. Thus the rate from Pittsburgh to New York may be 25 cents when the rate from Chicago to New York is 40 cents, though the distance from Pittsburgh is less than one-half of the distance from Chicago. The enforcement of such a regulation, it is probable, would make it impossible for the line against which it was received to do any through business. The Wabash road would not be likely to cut a through rate of 45 cents from St. Louis to New York if it had to pay the Canada Southern and New York Central 40 cents of that rate after carrying the freight 433 miles from St. Louis to Toledo.

But the trouble is in enforcing such a regulation. In the first place, the original organ of the combination was that most ineffective of administrative instruments, a committee. Moreover, it was a committee of the interested parties, formed of the very men against whom it might be necessary to enforce the regulation. In the next place, the managers of the trunk lines are also, some of them, managers of western connections. As trunk-line managers they were to be called upon to cut off their own heads as western line managers. Mr. Wm. H. Vanderbilt, the President of the New York Central, may any day be called upon to punish Mr. Wm. H. Vanderbilt, the President of the Lake Shore. In too many cases the executioner and the prisoner are the same person.

The meeting in New York two weeks ago provided for some of these defects, by appointing a disinterested officer to act partly as the agent of the Executive Committee, to collect information, investigate charges, report upon them, and recommend measures to remedy any disturbances. This is work, much of it, at least, which the Executive Committee cannot do directly. The disinterested official, hearing the complaints of all the interested parties and investigating them, can at least ascertain the actual state of things, the interests of the several parties and the manner in which and extent to which they are affected by the operations of each other; and if the present arrangement cannot be carried out in times of dull traffic, his experience, especially if he is given materials for the preparation of full statistics of the east-bound traffic, may afford information for some future effective combination on a firm and equitable basis.

The complaints now made are by the connections of the Baltimore & Ohio and the Pennsylvania railroads against the lines north of them. The companies named assert that they have maintained rates strictly, and support their assertion by the statistics of Chicago shipments recently, which show, it is said, that they have substantially lost all their business there. Whether they have not made up their losses at Chicago by gains further south may be a question, as the grain receipts at Philadelphia and Baltimore have not been small, but very large recently, and for the last week of December they were larger than for any week last winter.

The conference in Chicago last week does not seem to have had any direct result, except the appointment of another to be held this week in New York, when it is possible that application will be made to the trunk lines to enforce the rule and require local rates for freight coming from the offending connections. But it seems that more is expected from the weather than from any action under the old agreement or any new combination. With tolerable roads there is promise of traffic enough to keep all the cars of all the roads tolerably busy, and under such circumstances there is little temptation to cut rates. But one thing seems certain, and that is that if the condition things for the past few weeks is not remedied, there will be open war, and the winter traffic will yield very little profit to anybody.

THE MAXIMUM POWER OF LOCOMOTIVES.

The following extract is from one of a number of letters which are received by us from time to time, and which have suggested the idea that a little plain elucidation of the subject might be useful and interesting to many readers. The following is the essential part of the letter referred to:

"I want an engine to haul 30 cars weighing 600 tons up a 50-feet grade. I have assumed that one with 18×24 in. cylinders with three pairs of 50-in. drivers, and with a pony truck and a steam pressure of 130 pounds per square inch, and a speed of ten miles per hour will do the business. Now, I want to demonstrate by figures just what this engine will do, and also determine the necessary weight of the engine. I first worked out the tractive power from the rule on page 322 of the 'Catechism of the Locomotive, and found it to be 17,118 lbs. Then I found the required adhesive weight (page 412) to be 76,900 lbs. Now comes the trouble: I can find no rule to connect the tractive power with the adhesive weight; or, in other words, will a tractive force of 17,118 pounds be sufficient or not to move the engine with 76,900 lbs. adhesive weight and a train weighing 600 tons up a 50-feet grade at 10 miles per hour? It is necessary to prove this beyond a doubt, but I can find no rule for so doing in the 'Catechism of the Locomotive' or in any other text book."

Our correspondent has commenced at the wrong end of the calculation. The first thing to do is to find how much power will be required to pull the train. The existing knowledge relating to this point is not very exact or satisfactory, but we will not fall into serious error if we assume that a force of 6½ lbs. per ton (of 2,000 lbs.) will keep an American car in fair condition moving, on a tolerably good, straight and level track.

As there are 5,280 feet in a mile, on a grade of one foot per mile the resistance will be increased $\frac{1}{5280}$ on account of the grade. If the latter was ten feet per mile, it would be increased $\frac{10}{5280}$, and for a fifty feet grade it would be increased $\frac{50}{5280}$. Therefore the power to move one ton of weight up a grade of 50 feet per mile will be equal to $\frac{2000 \times 50}{5280} + 6\frac{1}{2} = 25.4$ lbs.

This will be the power required to move a ton of load at a slow speed. If the speed is increased the power must also be increased in a proportion which is not understood very exactly, but below a speed of 10 miles per hour the above figures are nearly correct. Therefore to get the resistance per ton of a train on a straight track, at a slow speed, *multiply 2,000 lbs. by the rise in feet per mile, and divide by* 5,280; *then add to the quotient* 6½ *lbs.: the sum will be the resistance in pounds per ton (of* 2,000 *lbs).* A similar rule has been employed in calculating a table given on page 596 of the book already referred to. The resistance due to higher speeds has also been calculated and is given in that table, but that feature will not be discussed here, as we are at present chiefly concerned in determining the maximum power of a locomotive in drawing trains at speeds not exceeding 10 miles per hour.

Of the influence of curves on the resistance of trains there is almost absolutely no information worthy of the name. Molesworth's pocket-book contains the rule that "the resistance of curves may be reckoned as 1 per cent. for each degree of the curve occupied by the train." Whether this means that the resistance will be equal to 1 per cent. of the weight of the train, or that the resistance on the curve will be 1 per cent. greater than on a straight

line, for each degree occupied is not clear. If the former it cannot be correct, because on a curve of 600 feet radius our train of 30 cars and an engine would occupy over 100 degrees of the curve, so that it would, according to the rule, take as much power to draw it on the curve as to lift it up vertically, which result bears its own refutation on its face. If the second construction is the meaning of the rule, then it would give the resistance of our train on a curve of 600 feet radius as double what it would be on a straight line, which is probably less than the actual resistance.

In working a temporary track over the Blue Ridge at Rock Fish Gap in Virginia, Mr. Ellet found that the resistance due to a curve of 300 feet radius with the flanges of the wheels oiled was equivalent to that due to a rise of 58.4 feet per mile. In Spon's "Dictionary of Engineering," page 1,335, some experiments are reported in which the resistance due to curves of 1,000 meters (3,280 feet) radius was increased 2 lbs. per ton (of 2,000 lbs.), and on curves of 800 meters (2,624 feet) radius it was 3 lbs. per ton. Probably the resistance on curves bears some direct proportion to the degree of curvature as expressed by civil engineers in laying out such curves. Calculating from the above data in this assumption, we find that the resistance found by Mr. Ellet on a curve of 300 feet radius, 19 degrees nearly, was that due to a rise of 58.4 feet, which is equal to 22 lbs. per ton, or 1⅛ *lbs. for each degree* of curvature. From the experiments in Spon's Dictionary we have a curve of 3,280 feet radius=about 1¾ degrees, on which the resistance due to the curve was 2 lbs. per ton, or about 1⅛ *lbs. per degree;* on the curve of 2,624 feet radius.=2⅛ degrees, the resistance due to the curve was 3 lbs., or about 1⅛ *lbs. per degree.* In Hamilton's "Useful Information for Railway Men" it is stated that "the resistance to traction of a train on a level is doubled by a radius of curve of 400 feet=14¼ degrees (or nearly 1 *lb. per degree*), and 13 lbs. per ton is the additional friction upon a curve of 300 feet"=19 degrees, or about ¾ *lbs per degree.*

From these data a very rough but unsatisfactory rule, or rather assumption, might be adopted, that the resistance due to a curve is 1 lb. per degree of the curve. By the degree of the curve is meant the deflective angle, and not some proportion of an entire arc used to designate the length of the curve, as the term is probably intended to mean as it is used in Molesworth's and Hamilton's pocket-books. It must also be remembered that the curves on a railroad are seldom long enough to take the whole of a long train at one time, and that it is only those cars on the curve that are subject to its influence.

It should be kept in mind, too, that the load an engine pulls is that of the cars *and* tender. The latter, for a large engine, may be assumed to weigh 25 tons loaded, so that the total load of our train would be 625 tons. With reference to the power required to move the engine, we will speak hereafter. By the table already referred to it will be seen that the resistance on a grade of 50 feet per mile is 25.5 lbs. per ton (of 2,000 lbs.), a slight increase being added in the table over that calculated above for the speed of the train. The resistance of the latter, if the track on the grade is straight, will therefore be 625+25.5=15,937.5 lbs. If there are curves on the grade, an addition must be made for them. Thus if there is a curve of 900 feet radius = 6⅓ degrees, on the grade and long enough to take the whole train, then we must, according to the assumption made above, add 6⅓ lbs. per ton, so that the total resistance will be 19,895.5 lbs. If the curve is only long enough to take half the train, then the additional resistance due to the influence of the curve should only be calculated for that portion of the train which can be on the curve at one time.

In order to be able to exert sufficient tractive power to draw this load, the engine must have enough weight on the driving-wheels so that their adhesion to the rails will exceed the force which must be exerted. On page 412 of the "Catechism of the Locomotive," as stated by our correspondent, the adhesion is said to be about *one-fifth* of the weight on the wheels, and therefore that weight must in this case be five times the resistance of the train, or 99,479 lbs.

It has usually been considered necessary to add to the weight of the train that of the locomotive in calculating the adhesive weight. It has recently been pointed out that this is unnecessary, because no adhesion of the driving-wheels is necessary to overcome the friction of the mechanism of the engine. If the latter was raised off from its wheels it would still be able to overcome the resistance due to the friction of the machinery. It is only the rolling friction of the driving-wheels which is added when the locomotive runs on the track, and this may be disregarded at present. If there is any considerable weight carried on the engine trucks, doubtless this should be added to the weight of train in calculating the resistance of the train, but it has, in the present case, been omitted.

The rule, given on page 322 of the book several times referred to, for finding the tractive power of a locomotive is to "multiply together the area of the piston in square inches, the average steam pressure in pounds per square inch on the piston during the whole stroke, and four times the length of the stroke of the piston (in inches), and divide the product by the circumference of the wheel (in inches). The result will be the tractive power exerted at the rails in pounds."

In making this calculation the most difficult matter is to determine the effective average pressure in the cylinders. It would lead to error to assume that the average pressure in the cylinders ever is the same as in the boiler, because in the first place no ordinary link motion admits steam during the whole stroke, although we are in the habit of speaking of an engine working at "full stroke." They all cut off the steam at from three-quarters to four-fifths of the stroke when the reverse lever is in the lowest notch. Besides there is considerable loss due to condensation, and a deduction must always be made for back pressure, so that, as has been explained in Clark's "Treatise on Railway Machinery," page 113, the average mean effective pressure when working at four-fifths of the stroke is 10 per cent. less than the boiler pressure. This deduction should therefore always be made.

The friction of the mechanism of the engine has also been named as absorbing a considerable amount of power. The amount of loss due to this cause is, however, very imperfectly understood. In Hamilton's book it is given at 17 lbs. per ton, and as our locomotive must weigh about 56 tons, the total resistance would thus be 952 lbs., or about 5 per cent. of that of the train. In Spon's Dictionary, page 1,353, the resistance of locomotives is given as follows:

1. Resistance due to the motion of the engine considered as a mere vehicle	12.3	lbs. per ton.
2. Resistance due to the friction of the mechanism.	12.1	" " "
3. Resistance due to the additional friction caused by the pressure of steam	6.0	" " "
Total	30.4	" " "

This, it will be seen, is nearly double that given in Hamilton's book. The authority of Hamilton's statement is not given; whereas the latter was based on experiments which were carefully made. Experiments made by Mr. Hayes on the Illinois Central Railroad showed that the power consumed in running an engine is considerably greater than is usually supposed. It will, therefore, be safest to assume that 10 per cent. of the effective steam pressure is absorbed in working the engine alone. If then we have 130 lbs. pressure in the boiler, we must first deduct 10 per cent. in order to get the average cylinder pressure when working at what is called full stroke. The average cylinder pressure will therefore be only 117 lbs., and from this 10 per cent. more should be deducted for working the engine itself, and we will have 105.3 lbs. left as the pressure which is effective in producing traction. With this, and calculating from the rule already given, and with the dimensions of cylinders and wheels proposed, we find that the tractive power of such a machine would be 16,384 lbs.—enough to take the proposed train up a straight incline but not enough to take it up if the track is curved.

What will be observed in these calculations is the undetermined quantities, or those about which we have no exact or reliable knowledge, and in calculating which data must be assumed which are little more than guesses which a few isolated facts suggest.

The Winter Grain Movement.

Although there has been universal complaint of bottomless mud in the Northwest, preventing deliveries of grain at country stations, still the grain movement during the first month after the close of navigation was something extraordinary. Especially is this the case when we take into consideration the great advance in rail rates this year over last winter's rates. In December, 1876, the grain was substantially all carried as low as the basis of 20 cents per 100 lbs. from Chicago to New York. This year the rate has been twice as high, and though it is charged and is doubtless true that some roads have carried below the regular rate, yet we understand that 32 cents is supposed to be the lowest rate made yet. Low rates, however, cannot create grain, and a year ago there really was not a great deal of grain to carry. That year, however, the arrivals at the great Northwestern markets were unusually large, and in this movement this year shows a decrease of about 8 per cent., which we suppose is chiefly chargeable to the mud. It may, however, be partly due to a greater amount of direct shipments to the East from the country stations without passing through any of the eight great markets, and, this appears probable by the great difference between the shipments from Northwestern markets and the receipts at the seaboard. The latter were nearly three times as great as the former, and the disproportion is greater than in previous years.

The December movement of grain for five years past is shown below:

The receipts at the Northwestern markets (St. Louis, Peoria, Chicago, Milwaukee, Duluth, Detroit, Toledo and Cleveland), for the four weeks from Dec. 1 to Dec. 29 were:

1877.	1876.	1875.	1874.	1873.
9,732,636	10,560,163	8,651,061	1,370,196	10,414,185

The shipments of the same markets for the same weeks were:

1877.	1876.	1875.	1874.	1873.
4,721,222	4,936,806	3,637,639	2,232,104	4,614,745

And the receipts at the Atlantic ports for the same time were:

1877.	1876.	1875.	1874.	1873.
12,536,091	8,761 930	6,594,608	626,822	6,758,480

Here we see that in spite of the mud the arrivals at Northwestern markets were larger last December than for that month in any preceding year except 1876 and 1873, that the shipments of those ports show the same progress, with very little decrease since 1876; while the receipts at the sea-board have been enormously greater than in any previous year—43 per cent. more than in 1876, 90 per cent. more than in 1875, and twenty times as great as in 1874. The mud seems not to have prevented the grain's getting to the sea-board, though it checked the movement to and from the great Northwestern markets; and as there was no great stock to draw upon outside of these markets, except at Buffalo, we conclude that direct through shipments have been unusually large. The distribution of the grain at the different ports is greatly affected by the close of navigation, as we have often pointed out. But this year unusual interest attaches to this distribution, for two reasons: First, it is the first year when the differences agreed upon a year ago of two cents per 100 lbs. in favor of Philadelphia and three cents in favor of Baltimore have been applied to the traffic. (Heretofore the differences have been greater). Second, there are charges that the northern roads, which carry chiefly to New York and New England, have been securing an undue share of the traffic by cutting rates. The latter could not, it is true, be established by the receipts at the different ports; for now (and it is important to keep this in mind) all the trunk lines carry to all three of the great grain ports, and if one cuts the regular New York rate, it is likely to cut the Philadelphia and Baltimore rates to the same extent leaving the differences just as they were before. We have shown above that there was a great increase in the total seaboard receipts in 1877, and we will see below how the receipts were divided among the different ports.

The receipts for the past four weeks at the seaboard cities were:

	1877.	P. c. of total.	1876.	P. c. of total.
New York	4,599,736	36.7	3,385,460	38.6
Philadelphia	2,532,620	20.2	1,745,200	19.9
Baltimore	3,216,500	25.7	2,296,400	26.2
Boston	894,031	7.1	842,341	9.6
New Orleans	1,108,853	8.8	329,284	3.8
Portland	158,400	1.3	145,480	1.7
Montreal	26,851	0.2	18,765	0.2
Total	12 536,991	100.0	8,762,930	100.0

The changes in proportion are very small for the three great exporting cities. If they were getting their share of the business last winter they have been this. Philadelphia and Baltimore together got 46.1 per cent. of the total in December, 1876, and New York 38.6 per cent. In December, 1877, New York received 36.7 per cent. and the two Southern cities 45.9 per cent. And, we may say, these proportions were not greatly different for the whole of last winter, so far as Philadelphia and Baltimore are concerned. During the first four months of 1877 they together received 48.3 per cent. of the total arrivals at the seaboard. Nothing in the figures so far reported indicates any extraordinary diversion of grain by "cut rates" or otherwise. All the ports are getting more than last year, and the three leading cities have kept up about last year's proportions.

The mild weather and mud of December have now given way to true winter weather and solid roads, and it is reasonable to suppose that the grain movement will profit thereby, and that the winter traffic will be the largest ever known. The effect of the bad roads, however, will probably be seen for some time yet. Receipts at the Northwestern markets will probably improve directly, the shipments a trifle later, while the effect on sea-board receipts will hardly be great for a week longer. The latter, however, have been eminently satisfactory all the time.

That the prospect for large profits is as good as for large traffic, unfortunately cannot now be said. It does indeed seem that nothing but madness could destroy the present opportunity, which all the roads need to take advantage of; but we can hardly say that any given policy is improbable because it is foolish or ruinous, when it refers to conduct of railroad companies in competing for business. If, however, the business should be so large as to crowd the roads, which is entirely possible, even madness itself will hardly begin a railroad war.

Record of New Railroad Construction.

This number of the *Railroad Gazette* contains information of the laying of track on new railroads as follows:

Rochester & State Line.—Since last advices 36 miles of track have been laid, leaving only five miles to be put down to complete the road.

Pittsburgh, Wheeling & Kentucky.—Extended from Wellsburg W. Va., southward 13 miles to a point near Wheeling.

Olean, Bradford & Warren.—The section of this road in New York is completed from Olean, N. Y., west by south to the Pennsylvania State line, 12¼ miles. It is of 3 ft. gauge.

This is a total of 61¼ miles of new railroad, making 2,172

miles completed in the United States in 1877, against 2,354 miles reported at the corresponding time for 1876, 1,560 in 1875, 2,025 in 1874, 3,883 in 1873, and 7,340 in 1872.

THE EUROPEAN GRAIN MOVEMENT is looked upon with unusual interest here this year, as likely to affect our winter business. With regard to the movement of grain on the Continent, and especially Russian grain, to which attention has been called in this country recently by a communication from the American consul at Odessa, the *Journal* of the German Railroad Union for Nov. 30 says:

"The volume of traffic on the lines from Odessa to Danzic and Koenigsberg is more colossal than ever, and to our lines in the Northeast it is no easy task to move it, the difficulty of which will increase still more hereafter, not only because there are now in Odessa 3,500,000 poods (2,000,000 bushels) awaiting shipment, but because the chief quantities brought to the railroads in Russia for all considerable distances can only be hauled by sleds. A Russian saying is, 'Winter makes us roads.' The recent tariff convention at Moscow established a reduced winter tariff, and the prohibition of exportations by way of the Black Sea and the Sea of Azof, and thus has turned the supplies to the overland route of the West."

The Austrian export for October is spoken of as extraordinary; the figures given show it to have amounted to about 15,000,000 bushels, only 3,900,000 of which was wheat.

FRICTION, LUBRICATION AND LUBRICANTS will be continued as the subject for discussion at the regular monthly meeting of railroad men and others to be held at the rooms of the Master Car-Builders' Association, No. 113 Liberty street, New York, Thursday evening, Jan. 17, 1878, at seven o'clock. These subjects were treated by Professor Thurston at the December meeting in an extremely interesting and valuable address, which we will report next week. At the coming meeting a paper from Mr. F. S. Pease, of Buffalo, will be read. This will be fallowed by a discussion of the rate of deterioration of railroad cars, adjourned from the November meeting. Every body is invited.

The First Railroad in Illinois.

The history of the first railroad in Illinois is told as follows by a correspondent of the Quincy *Whig*, who writes from Meredosia, in that State:

The first railroad ever built in Illinois was not what people would now call "a big thing;" but in those days it was something "not to be sneezed at." It was built from this place to Springfield about forty years ago, and as the men who took part in that enterprise are nearly all gone, I avail myself of the opportunity to record some of the recollections of two old citizens of this place, Mr. David Waldo and Mr. E. Lusk, who had a hand in its construction.

It is not enough to say that this little bit of road was the first ever built in Illinois; it was the first built in the Mississippi valley. The first road in the United States had been built about twelve years before from Albany to Schenectady, in the State of New York, and at the time of which I now write, one was in operation from Baltimore to Washington, and probably one or two more short pieces of road elsewhere. They were mere suggestions, however, of the systems of roads of to-day, and it is an easy matter for the curious reader to find their location and the date of their construction by reference to any standard cyclopedia.

The first charter granted for the construction of a railroad in Illinois, was granted to Gov. Joseph Duncan and his associates in 1833 or 1834. Duncan seems to have thought that, as he was a Member of Congress, he could command influence and capital to help on his project; but when Eastern capitalists were approached on the subject they laughed at the idea of building a railroad in a region which they regarded then as little better than a wilderness.

Thus the enthusiasm of the first step was checked, and the project lagged until the winter of 1835–6. Duncan had then been elected Governor of the State, notwithstanding his disaffection toward Jackson and the democrats; and in his first message he referred in the most glowing language to the triumph of the canal boat and the locomotive in "almost annihilating time, burthen and space" in other quarters of the country, and wanted to know if the patriot bosoms of Illinois did not beat high to emulate such examples of internal improvement. That year the internal improvement bill was passed, and the earlier project of Duncan's road was abandoned.

Under the improvement bill roads were laid out for every quarter of the State. The map was checkered with them. The bill provided for a board of commissioners, and at the first meeting of that board it was decided to commence the first operations in Morgan County, on the line laid out as the Northern Cross railroad—practically the line on which the Wabash road is now built—for in the internal improvement bill the points named for this road were Quincy, Mt. Sterling, Meredosia, Jacksonville, Springfield, Decatur, Danville and thence to the State line.

The contract for building that part of the road from Meredosia to Springfield was let to Thomas T. January, James Dunlap, Miron Leslie and Charles Collins. It was surveyed by James Bucklin, assisted by George W. Plant and John Van Horn. The profile of the work was drawn by a Pole named Edward Mehogelowski, a noble by birth, who had left Poland on account of some of the rebellions or persecutions there. He was a man of fine attainments and high character. After this survey and location, the division of the road beginning at the Illinois River at this place and extending to Van Gundy's, the first station east of here—about a mile east of where Bluff City now stands—was sub-contracted to J. C. & S. P. Thompson, D. & J. E. Waldo and Harvey Duncan.

When everything was ready to begin work, it naturally appeared that so important an enterprise should be inaugurated with some formal ceremony. The day for beginning arrived late in the autumn of 1837, and the sub-contractors took their men, accompanied by a large number of citizens: to the point whence the road was to start, on the bank of the river. There Mr. J. E. Waldo, now living in New Orleans, and Dr. Owen M. Long, now consul at Panama, were chosen speakers for the occasion. The toast-master of the day was Samuel Talmage, a noted character of that period. The day was given up to speech-making, jollification and hilarity, and it would be very interesting at this distance if one could report some of the wonderful orations delivered. One of the toasts is distinctly recalled thus: "Our friend, T. T. January—A man with a cold name but a warm heart." Mr. January is still living and is a wholesale trader in St. Louis. Mr. D. Waldo, now the postmaster here, being then the oldest man as well as the oldest citizen of the place, was designated to dig the first spadeful of dirt. The labor he performed was all the work done on the road that day.

The work of grading went on all winter and was finished in April. The track was laid by putting down a piece of square timber called a mudsill, on the top of which cross ties were laid. On these a wooden rail was laid and flat bars were spiked on top of the rail. The bars were 2¼ inches wide and 1 inch thick. It is not now distinctly remembered whether this iron was of foreign or domestic manufacture; but it was brought by way of New Orleans to St. Louis, and there delivered from the steamer Vandalia to the steamer Quincy, then run by J. H. and E. Lusk between St. Louis and this place.

The first locomotive that ever turned a wheel in the Mississippi valley was brought here in pieces and set up to operate this earliest Illinois railroad. It was made by Rogers, Grosvenor & Ketchum, of Newark [Paterson], N.J., and was landed here from the steamer Quincy in the autumn of 1838, soon after the iron had been laid on the road. It was a curious little contrivance, and, as compared with the more modern construction of locomotives, was a consummate piece of clumsiness. The driving-wheels were about 2½ feet in diameter, and, in every other respect, it compared equally well with the locomotives of to-day.

A man by the name of Fields came out with the engine to set it up, and, on the day he got it on its feet, the jollification ran so high that he got off his, and had to be carried to the hotel for repairs. On the way he protested that they were heaping undeserved honor upon him, and begged to be laid down and treated as a man of no distinction or eminence. He was the first engineer on the road, and ran the little engine—which was called the Rogers—for about a month. Afterwards a man by the name of Higgins ran it; but he melted out some of the flues and at last got discharged for dissipation. Finally two young men by the name of Gregory were put in charge of it, and after a while they succeeded in running the engine off the track between New Berlin and Springfield.

They seem to have been unable to replace it on the track for it lay out on the prairie for a year, or a year and a half, and was then sold to Gen. Sample, who practically bankrupted himself in various futile efforts to reconstruct it into some sort of road-engine for hauling freight across the country from Alton to Springfield in competition with the railroad. There was another engine put on the road, but it never set the river on fire. A citizen now living at Jacksonville tells how he started from Springfield one day with his horses and wagon just as the thing they called "the train" started, and he determined to run a race with it to Jacksonville. He kept ahead readily, and when, about a mile from his destination, it seemed to be gaining on him, he whipped up a little and won the race. This story, of course, is to be taken *cum grano salis* for the flavor of the joke.

At last mules were substituted for the engine, and were used till the road passed out of the hands of the State for the consideration of $100,000 in State indebtedness, its original cost to the state having been $1,000,000. Thus the State learned, at a cost of $900,000, that it lacked, somewhere, in the matter of capacity for the successful conduct of railroad enterprise. The charter of the road was amended in 1853, and it then took the name of the Great Western. It went into new hands, T rails were introduced, and everything relating to the first railroad in Illinois was swept away by the tide of modern railroad improvements.

Massachusetts Railroads in 1876-77.

From advance sheets of the ninth annual report of the Massachusetts Railroad Companies, covering the year ending Sept. 30, 1877, we take the following:

RAILROAD CONSTRUCTION.

In the last (eighth) report of this Board attention was called to the fact that for the first time since the work of building railroads in Massachusetts began, in 1835, it had during the year for which that report was made (1875-6) practically ceased. No new enterprise had been completed during the year, and the average annual construction of 50 miles during the forty previous years had fallen during that year to only 20 miles. The same condition of affairs as respects new construction which prevailed in 1875-6 continued in an even more marked degree throughout 1876-7. But 17.250 miles of new road in all were built, of which only 6.620 miles were of the standard (4 feet 8½ inches) gauge, while 10.630 miles were of the narrow gauge.*

NUMBER OF CORPORATIONS.

Returns have been received from 63 corporations. As compared with last year the names of three corporations have disappeared from the list; † those of three ‡ more have been added to it, and the name of one, § omitted from the returns of last year, has been restored.

COST OF ROADS.

The average cost of the roads of the standard gauge is returned at $57,964.70 per mile, exclusive of equipment, which has amounted to an additional sum per mile of $6,361.63 The narrow-gauge roads are returned at $18,563.20 per mile, and $4,042.33 additional for equipment. The average cost of an equipped road, irrespective of gauge, is returned at $63,488.20 per mile, but varies from $110,219.50 for the Boston & Albany to $4,595.96 for the Billerica & Bedford.

[We consolidate the statements of mileage and capital as follows:]

	Total.	In Massachusetts.
Miles of road	2,496.082	1,854.628
Miles of secured track	627.514	440.594
Miles of sidings	763.858	575.416
Total miles of track	3,887,454	2,870,638

	1877.	1876.	Inc. or Dec.	P. c.
Stock	$118,170,201	$118,179,615	Dec.. $9,414	....
Debt	52,914,825	51,620,374	Inc.. 1,294,451	2.5
Total	$171,085,026	$169,799,989	Inc.. $1,285,737	0.8
Per mile of road—				
Stock	$47,270	$47,274	.....	....
Debt	21,167	20,648	.....	....
Total	$68,437	$67,922	.....	....

EARNINGS.

The total gross income for the past year amounts to $30,008,513.74, a falling off of $998,934.58, or 3.22 per cent. from that of the year preceding. The gross income is, however, derived from a number of sources outside of the legitimate railroad business of the companies Its volume, therefore, does not necessarily represent the results of that business. As, however, under ordinary circumstances, the annual volume of the earnings of the railroad companies, derived from their legitimate business, furnishes probably as reliable a measure as can be devised of the prosperity or otherwise of the community, it is extremely interesting to know what that volume is. During the railroad year 1872-3, the transportation earnings of the Massachusetts companies were the largest ever reported by them. Since that time the returns for each year have indicated a regular falling off from the year previous The gross amount and percentage of this annual decrease is shown in the following table:

	Total transportation earnings.	Decrease from previous year.	Percentage of decrease from previous year.	Percentage of decrease from 1872-3.
1872–3	$33,856,977 99	.....	.....	.....
1873–4	33,165,594 77	$691,383 22	2.04	2.04
1874–5	31,494,865 19	1,670,729 58	5.04	6.07
1875–6	29,855,800 39	1,639,064 80	5.24	11 81
1876–7	28,931,987 62	923,812 77	3.10	14.54

It will be noticed that the falling off from the high-water mark of 1872–3 now aggregates a total of $4,924,990.37, or 14.5 per cent., the shrinkage in four years. It should, however, also be noticed that the falling-off process at last shows distinct signs of coming to an end, as, though in 1875–6 it was no less heavy than in 1874–5, last year (1876–7) it was over $700,000 less than in either of the two previous years.

Carrying the analysis one step further, it appears that during the last year, unlike the year before, the whole decrease sustained was in the receipts from passenger business. These fell off $1,047,945.27, or 7.2 per cent. A still further analysis shows that $479,436.06 of this aggregate loss was sustained in the through passenger department, and $568,509.21 in the local. As respects the first, the loss is probably largely due to the absence of the heavy Centennial Exposition travel, which was such a considerable item in the summer of 1876. The falling off in the local receipts is, however, unquestionably due to general business depression, and affords a very striking indication of it. The local passenger traffic has generally been considered the most reliable which a railroad can enjoy, and it is certainly the last to feel the effects of any business depression. During the last year, however, it will be noticed that the receipts from this source suffered, both relatively and positively, a heavier falling-off than those from any other.

During the year just closed the receipts from freights increased $163,800.57 over those of the year preceding, or 1.2 per cent., in place of the heavy decrease which had been reported during each of the two preceding years. This increase was due to larger volume of the through tonnage, it having increased 12 per cent. during the year. This increase of earnings from this source during the year amounted to $246,453.44, while the decrease from the local freight earnings was $82,652.87. Into the total decrease reported, ($923,812.77,) there also entered the further item of $33,968.07 decrease in receipts from mails, express, and extra baggage not included under the heads of either freight or passengers.

Of the total transportation earnings of the year, 49 per cent. was received in the shape of freight, and 46 per cent. in that of fares. This indicates a somewhat noticeable change from previous years, as will be seen from the following table:

	Passenger earnings.	Per cent. of transportation earnings.	Freight earnings.	Per cent. of transportation earnings.
1871–2	$12,934,567 54	43	$15,855,569 93	53
1872–3	15,486,934 92	46	17,248,110 15	51
1873–4	15,872,687 15	48	16,053,447 08	48
1874–5	15,566,780 83	49	14,610,208 15	46
1875–6	14,631,719 86	48	14,036,146 69	47
1876–7	13,489,208 95	46	14,234,677 72	49

The fluctuation in the relative amount of freight as compared with passenger earnings is probably due to the general rapid and steady decline in through freights which has taken place during the last ten years.

In conclusion, it would appear, therefore, that as compared with the two previous years, there was, during the last year, a continued shrinkage in the receipts from the local freights, and from both local and through passengers. From through freights only was there an increase, and this was probably due to the firmer rates charged on shipments of breadstuffs and provisions for exportation under the stimulus of war prices. Meanwhile, it is also apparent that the falling-off in each of the departments, in which a falling off took place, except that of local passenger business, was less than it had been in any year since 1874–5.

EARNINGS PER MILE OF ROAD.

The average sum earned on each mile of main track and branch road operated was $11,735.22; if, however, the double track is computed as additional single track, the average amount earned per mile was $9,314.52. The amount varied from $25,859.52 per mile on the New York, New Haven & Hartford road to $1,228.70 per mile on the Grafton Centre. Upon the eight roads running out from Boston, the average amount earned per mile was $11,899.33.

COST OF OPERATION.

The cost of operation throughout the State has been $8,494.18 on each mile of road in use, or 68 per cent. of the gross earnings as compared with 69 per cent. for the preceding year. On the eight Boston roads it has been $8,421.87 per mile of road operated, or 70 per cent. of the gross earnings as compared with 70 per cent. for the preceding year. The increased efforts at economy during the past year resulted in an average reduction of $342.22 per mile in the cost of operating throughout the State as compared with the preceding year, and $703.93 per mile average reduction on the eight Boston roads. The heaviest reduction effected was on the New York, New Haven & Hartford, where the cost of operation was reduced during the year, $2,309.15 per mile, or 13.6 per cent. from the preceding year.

NET INCOME.

The total net income reported is $9,344,088.38, or 5.5 per cent. on the permanent investment—that is, on the value of the properties as they stand on the books of the corporations. This sum was divided among the several corporations as follows:

12	Co's with	$6,504,808 00	permanent invest't, had no net income.
17	"	38,129,312 00	" " had 3½ per ct. or less.
14	"	13,431,205 00	" " from 3½ to 5½ per ct.
11	"	51,008,211 00	" " from 5½ to 7½ per ct.
6	"	40,172,677 00	" " from 7½ to 9½ per ct.
2	"	19,328,870 00	" " from 9½ to 11½ per ct.
62		$168,575,083 00	

VOLUME OF BUSINESS.

The total number of passengers carried was 38,450,823, a decrease of 2,682,406 from the preceding year. It will be observed that the aggregate falling off in the total number of passengers carried during the last year as compared with 1872–3, amounts to no less than 9.3 per cent., while that of season-ticket passengers has been 12.6 per cent. Meanwhile the decrease of freight tonnage since 1872–3 has been only 4.2 per cent. There were 11,910,663 tons of freight moved, an increase of 583,161 over the movement of the preceding year. The fluctuations during the last five years in the volumes of the freight,

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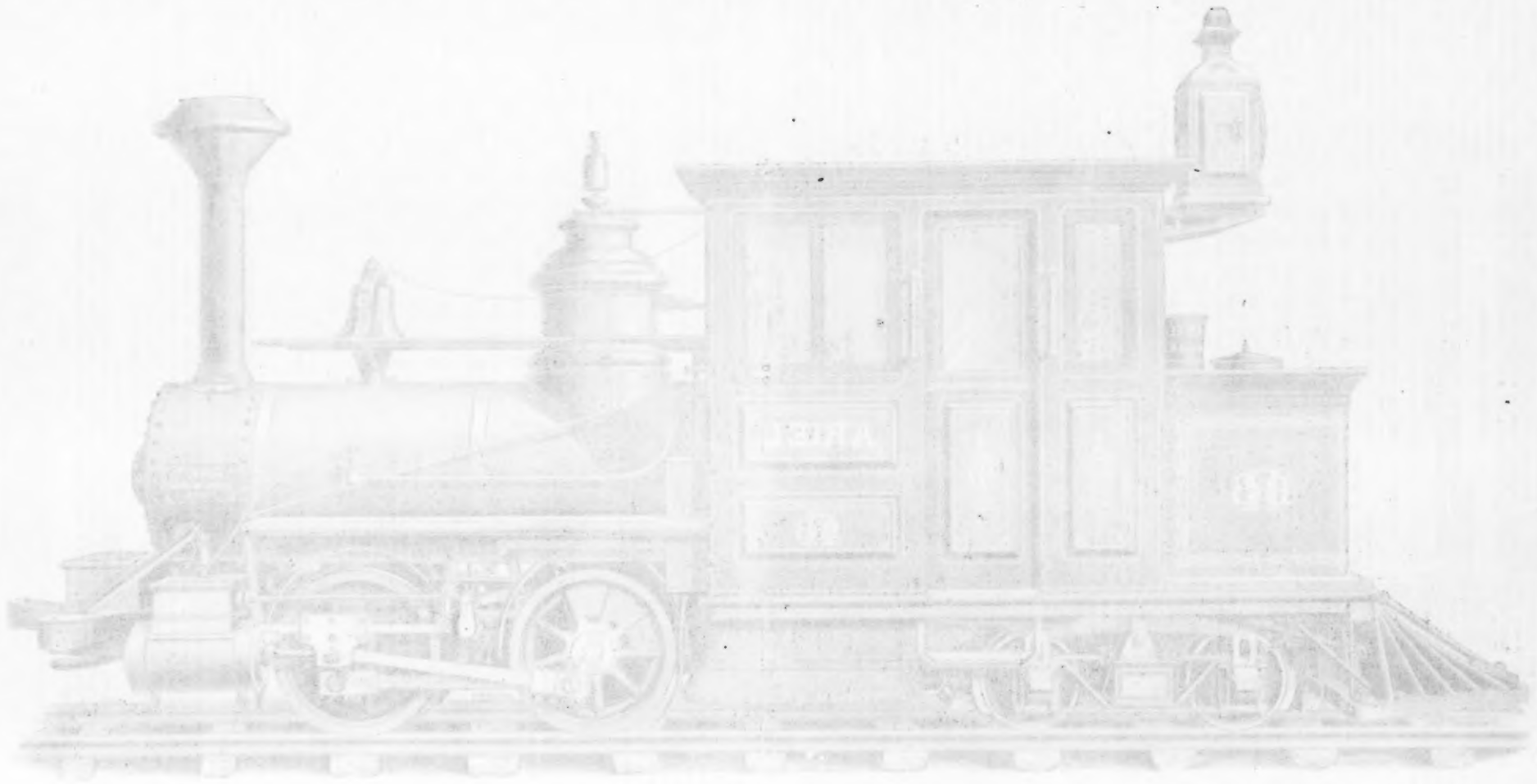
Miles.

* Billerica & Bedford—North Billerica to Bedford (gauge, 2 feet..8.630
Boston, Winthrop & Point Shirley—Winthrop Junction & Winthrop (gauge, 3 feet).....2.000
Rhode Island & Massachusetts—Franklin to Attleborough.....6.620
17.250

† The Boston, Clinton & Fitchburg, and the New Bedford, consolidated into the Boston, Clinton, Fitchburg & New Bedford; and the South Shore consolidated into the Old Colony.

‡ The Billerica & Bedford, the Boston, Winthrop & Point Shirley, and the Rhode Island & Massachusetts.

§ The Dorchester & Milton branch of the Old Colony.



TANK LOCOMOTIVE FOR THE BILLERICA & BEDFORD (2 ft. gauge) RAILROAD.

By the HINKLEY LOCOMOTIVE WORKS, *Boston, Mass.*

Weight of Engine in working order.. .....23,750 lbs.
Cylinders.....8 in. diameter x 12 in. stroke.
Driving Wheels.....30 in. diameter.

Total Wheel Base..... .....13 ft.
Driving Wheel Base..... .....3 ft. 6 in.
Grate.....30 in. long x 27¼ long.

passenger, and season-ticket passenger movement have been as follows:

	Tons of Freight.	Passengers.	Season-Ticket Passengers.
1872–3	12,431,188	42,398,001	6,655,443
1873–4	12,014,812	42,480,494	6,752,540
1874–5	11,072,312	42,139,671	5,574,136
1875–6	11,327,502	41,133,229	5,918,378
1876–7	11,910,663	38,450,823	5,811,649

DIVIDENDS.

Of the 63 corporations making returns, 28 paid dividends varying from 1 to 10 per cent., and averaging on the entire stock of all the dividend-paying roads 7.17 per cent., or one-third of one per cent. less than last year. The sum paid in dividends ($5,429,183.31) amounted to 4.6 per cent. on the entire stock capital of all the corporations, dividend-paying and non-dividend-paying. The sum paid in dividends in 1872–3 ($7,230,456.02) amounted to 6.34 per cent. on the entire stock capital of the railroads of the State, at that time. It would hence appear that since 1872–3, the average rate of dividend on the stock of the Massachusetts railroads has been reduced 29 per cent.

	1875.		1876.		1877.	
	No. of companies.	Amount of stock.	No. of companies.	Amount of stock.	No. of companies.	Amount of stock.
Paying dividends—						
10 per cent	4	$40,104,400	2	$18,097,800	2	$18,104,400
9 " "	2	6,100,000	1	20,000,000	0	.. ....
8 " "	5	15,889,574	5	13,600,000	2	22,100,000
7 " "	2	6,865,500	1	131,700	3	2,131,700
6 " "	4	1,073,950	5	8,032,700	8	17,035,500
5 " "	3	1,798,700	4	3,588,500	3	10,231,274
4 " "	2	5,013,000	3	4,578,100	4	2,896,600
3 " "	2	1,212,202	3	8,672,600	2	321,770
2 " "	1	97,000	1	800,000	2	547,126
1 " "	1	243,305	1	243,300	2	2,396,605
0 " "	37	37,127,572	36	40,434,915	35	42,505,226

As interest, the average rate being in the neighborhood of 7 per cent., $3,437,026 was paid, being $267,672 less than during the previous year,

COST OF RUNNING TRAINS.

The average cost of running a train one mile has been $0.918 for the passenger service, and $1.058 for the freight service. As this is the true test, certain necessary allowances for peculiarities of traffic and situation being made, of the economy or otherwise with which railronds are operated, the rates per mile at which the principal corporations reporting to this Board move their passenger and freight trains are shown in the following table. Where the figures are decidedly exceptional they necessarily give rise to grave doubts as to the accuracy with which books and accounts have been kept. It will be noticed that the variations are very large; the Springfield, Athol & Northeastern,* for instance, professing to move its passenger trains at $0.484 per mile, while the Boston & Providence† claims that the cost to it of a similar service is $1.140, or nearly two and one-half times as much.

	Cost of pass. train per mile run.	Cost of fr't train per mile run.
Boston & Albany	$0.861	$0.956
Boston & Lowell	0.783	0.913
Boston & Maine	0 857	1.046
Boston & Providence	1.140	1.363
Eastern	0.928	1.248
Fitchburg	0.930	1.079
New York & New England	0.948	1.282
Old Colony	1.005	1.178
Average eight roads	$0.922	$1.029
Boston, Barre & Gardner	$0.872	$1.417
Boston, Clinton, Fitchburg & New Bedford	0.935	1.056
Cheshire	0.712	0.601
Connecticut River	0.967	1.456
Nashua & Lowell	0.802	0 940
New Haven & Northampton	0.777	1.203
New London Northern	0.780	0.938
New York, New Haven & Hartford	0.970	1.260
Norwich & Worcester	0.810	1.090
Providence & Worcester	1.013	1.230
Springfield, Athol & Northeastern	0.484	1.031
Worcester & Nashua	0.821	1.057
Housatonic	0.644	0.976
Total average	$0.918	$1.038

The average cost per mile on all trains has been $0.980, or 6 per cent. less than last year. As the earnings per train mile run fell off 5.5 per cent. it would appear that those managing the several roads succeeded in effecting a reduction in expenses 8 per cent. in excess of what was necessary to make good the falling off in the earnings.

The average cost of train service per mile, as deduced from the returns of the last five years, is susceptible of division, as follows:

	1873.	1874.	1875.	1876.	1877.
Repairs of road-bed	$0.189	$0.157	$0.153	$0.110	$0.120
" bridges	.023	.021	.026	.018	.018
" buildings	.038	.037	.039	.026	.025
Renewal of rails	.081	.080	.056	.038	.046
Repairs of locomotives	.088	.087	.070	.063	.058
" passenger cars	.103	.114	.104	.095	.092
" freight cars	.151	.101	.111	.088	.094
Salaries	.372	.319	.337	.311	.301
Oil and waste	.018	.016	.015	.014	.013
Fuel	.183	.174	.147	.121	.126
Total	$1.246	$1.116	$1.058	$0.874	$0.863

The very heavy falling off in the item of "renewal of rails," amounting to 43 per cent. in five years, is the most significant feature of this table. It is largely due to the substitution of steel for iron. On the roads reporting to this Board the amount expended in renewals of rails was less by $809,398.13 in 1876–7 than in 1872–3, and yet, owing to the decreased cost of steel, the replacement of iron rails by steel has during the last year been going on with unusual rapidity.

PROPORTION OF PAYING WEIGHT TO DEAD WEIGHT.

The average number of passengers to each train during the last year was 60, and the average number of tons of freight was 70. The passenger trains, including locomotive and baggage cars, averaged 125 tons of dead weight, and the freight trains 220 tons. Consequently, the returns would seem to indicate that the railroad corporations of this State haul over two tons of rolling stock for each passenger they carry, and over three tons for each ton of freight. The fact, however, which has heretofore been noticed by this Board as throwing doubt on the accuracy of this conclusion, still remains unexplained. Certain of the roads, like the Old Colony, the Boston & Lowell and the Boston & Maine, profess to move an average of less than 50 tons of freight to a train of 25 cars.

TRAIN MILEAGE.

The total mileage of passenger trains run during the year was 10,479,546, or an increase of 39,690 over the previous year. As regards freight, 9,967,200 train miles were run, an increase of 502,729 over the year previous.

FARES AND FREIGHTS.

The average fare charged per mile on all the roads was 2.10 cents per mile, ranging from 8 mills per mile for season-ticket passengers for long distances to 10 cents per mile for single-ticket passengers for fractional parts of a mile. Any attempt to arrive at an average rate per mile of freight, excluding as it must all questions of distance carried, cost of terminal handling and classification, is simply deceptive. Taking each road by itself, the average rates of fare and freight charged upon it during each of the four last years is shown in the following table:

	Fares.				Freights.			
	1874.	1875.	1876.	1877.	1874	1875.	1876.	1877.
	Cts.	Cts.	Cts.	Cts.	Cts.	Cts.	Cts.	Cts.
Boston & Albany	2 47	2.40	2.37	2.31	1.82	1.53	1.28	1.21
Boston & Maine	1.88	2.10	1.99	2.03	3.59	3.20	2.77	2.31
Boston & Providence	2.34	2.32	2.10	2.20	3.73	3.36	3.13	2.70
Old Colony	2.30	2.24	2.20	2.10	4.13	4.04	3 98	3.60
Boston & Lowell	2.09	2.11	2.15	2.09	4.31	4.04	3.62	3.69
Fitchburg	2.20	2.1	2.10	2.00	4.33	4.13	2.80	1.71
Eastern	2.07	2.21	2.04	2 06	2.85	2.78	2.68	2.48
Connecticut River	2.85	2.75	2.78	2 69	4.00	3.97	3.97	4.00
New York, New Haven & Hartford	2.32	2.33	2.39	2.31	3.69	4.10	3.54	3.50
Providence & Worcester	2.63	2.52	2.52	2.31	3.32	3.46	3.12	2 99
Worcester & Nashua	3.17	3.46	3.18	2.88	3.23	2.94	3.13	2.74
New Haven & Northampton	2.97	2.93	2.97	2.97	3.60	4.14	3.43	3.42

The impression has generally prevailed that, owing to the cessation of hostilities between the various through lines, the rates on through business during the past season have been higher and firmer than for some time previous. This has certainly been the case as respects some of the principal staples. At the same time it would appear from the returns for this year that through freights on the average ruled even lower than the low rates to which attention was called in the last Annual Report of this Board (p. 8). This is made apparent from the following table, which shows the average rate per ton per mile charged in the years specified on merchandise received from or delivered to other roads:

	1875.	1876.	1877.
Boston & Albany	1.17	.96	.85
Boston & Lowell	2.77	2.60	2.50
Boston & Maine	2.40	2.40	2.10
Fitchburg	2.61	1.39	1.13
Cheshire	1.81	1. 1	1.68
New London Northern	2.30	2.08	2.10

The rapid reduction which has been going on in railroad freight charges during recent years is not generally appreciated. It will, however, be apparent on examination of the following table, showing the rate received per ton per mile by the Boston & Albany road through a period of thirteen years, since the close of the war of the rebellion. It will be noticed that the rate for 1877 is but 34 per cent. of that for 1865:

Years.	Rate.	Years.	Rate.
1865	3.55 cents	1872	2.02 cents.
1866	3.16 "	1873	1.96 "
1867	2.98 "	1874	1.82 "
1868	2.81 "	1875	1.53 "
1869	2.43 "	1876	1.28 "
1870	2.19 "	1877	1.21 "
1871	2.09 "		

STATEMENT *showing the gradual reduction in freight charges per ton per mile, on several transportation lines engaged in commerce between the Western States and the Atlantic seaboard, from* 1868 *to* 1876, *inclusive, from First Annual Report of the Internal Commerce of the United States, by Joseph Nimmo, Jr.*

Railroads.	Years.								
	1868.	1869.	1870.	1871.	1872.	1873.	1874.	1875.	1876.
	Cts.	Cts.	Cts.	Cts.	Cts.	Cts.	Cts.	Cts.	Cts.
New York Central	2.59	2.20	1.86	1.65	1.69	1.57	1.47	1.27	1.05
Pennsylvania	1.90	1.72	1.55	1.34	1.42	1.42	1.26	1.06	.89
Erie	1.92	1.60	1.37	1.47	1.52	1.45	1.31	1.21	1.07
New York State Canals	.88	.92	.83	1.02	1.02	.88	.73	.66	.68
Philadelphia & Erie	....	....	....	1.85	1.46	1.36	.94	.87	.77
Lake Shore & Michigan Southern	2.43	2.34	1.50	1.39	1.37	1.33	1.18	1.01	.82
Michigan Central	2.09	1.98	1 61	1.56	1.57	1.30	1.16	1.03	....
Chicago, Burlington & Quincy	3.01	2.77	2.31	2.19	2.18	1.92	1.90	1.91	....
Chicago & Northwestern	3.13	....	3.09	2.87	2.51	2.35	2.10	1.95	....
Average	2.26	1.97	1.91	1.74	1.67	1.54	1.36	1.21	....

STEEL RAILS.

During the year 200 additional miles of road have been laid in steel, making a total of 1,344 miles, or 43 per cent. of the whole mileage.

TELEGRAPH STATIONS.

During the year there has been a decrease in the number of telegraph stations connected with the operation of the railroad lines. Of these, 506 were returned for the last year in place of 531 for the previous year.

ROLLING STOCK.

The amount of rolling stock owned by the several corporations, returned for the last year, is materially larger as respects locomotives and freight cars than for the year previous; the number of locomotives increasing from 994 to 1,031, and that of freight cars from 16,836 to 17,292.

STATIONS.

The number of stations has heretofore been inaccurately returned. The figures on this point call for revision.

GRADE CROSSINGS.

The same remark must be made as to the crossings of railroads by highways at grade. If the returns are to be accepted as accurate, the number of these during the last year decreased from 2,776 to 2,245. No such decrease took place; the number, on the contrary, increased. The cause of this inaccuracy will be hereafter investigated.

SUMMARY.

In conclusion, it may be briefly stated that the average mile of single-track road (the mile of double track being estimated at two miles of single track) of which returns are made to this Board, has cost $45,000, and that its equipment has cost an additional sum of $5,500, making a total of $50,500 for the mile of single-track equipped road, which is represented by $38,000 of capital stock and $17,000 of debt. The gross yearly revenue from it is $9,700, of which $6,700, or 69 per cent., is consumed in the cost of operation, and $3,000, or 31 per cent., remains as profit. Forty-nine per cent. of the revenue is derived from the freight business, and 46 per cent. from passenger, and the balance from miscellaneous sources.

*The exceptionally high cost of operating per train mile on this road is probably due to the fact that the business of 66 miles of road is obliged to support an investment in terminal facilities and general office expenses sufficient for the wants of several hundred miles, but which cannot be reduced. It is the custom of the corporation, also, to charge new and additional rolling stock to operating expenses, instead of to equipment or property account, as should be done.

†In the case of this company, there are but few general office expenses the road is new, and little, if any thing, is being done towards maintaining its condition, and it is operated with as few trains as possible.

General Railroad News.

ELECTIONS AND APPOINTMENTS.

Baltimore & Ohio.—Mr. D. Lee, Master of Road for all the Trans-Ohio divisions, is relieved of the charge of the Chicago Division. Mr. A. C. Hoskin, late assistant to Mr. Lee, is appointed Master of Road of the Chicago Division. Mr. G. M. Hoffman, Supervisor of Trains of the Chicago Division, will act for the present as Assistant Master of Transportation, in place of H. S. Master, resigned.

Boston & Lowell.—At the annual meeting in Boston, Jan. 2, the following directors were chosen: Josiah G. Abbott, Wm. A. Burke, Thomas Talbot, Edwin A. Morey, T. Jefferson Coolidge. The only new director is Mr. Coolidge, who succeeds Francis B. Crowninshield, deceased.

Canada Southern.—Mr. E. R. Skinner is appointed Assistant Superintendent, with office at St. Thomas, Ont.

Chicago, Rock Island & Pacific.—Mr. R. H. Chamberlain has been appointed Trainmaster of the Illinois Division, and will also act as Superintendent, in place of T. B. Sargent, resigned. Mr. Chamberlain has been a conductor on the road for a number of years.

Chippewa & Red Cedar.—At the annual meeting in Eau Claire, Wis., Jan. 3, the following directors were chosen: A. Taintor, S. B. French, C. Wilson, Thomas B. Wilson, Menominee, Wis.; G. E. Porter, R. F. Wilson, Daniel Shaw, O. H. Ingram, G. A. Buffington, J. C. Thorp, W. H. Rust, H. P. Graham, Eau Claire, Wis.; Wm. Carson, St. Paul, Minn.

Cincinnati & Portsmouth.—The following officers have been elected for the ensuing year: Henry Brachman, President; D. K. Este, Vice-President; M. Simmons, Secretary; Aaron A. Colter, Treasurer; Paul F. Mohr, Consulting Engineer; W. H. Corbly, Superintendent.

Cleveland & Pittsburgh.—At the annual meeting in Cleveland, Jan. 3, the following directors were chosen: C. V. Painter, James F. Clarke, R. P. Ranney, Cleveland, O.; E. A. Ferguson, Cincinnati; J. N. McCullough, B. F. Jones, Pittsburgh; Thos. A. Scott, Philadelphia; August Belmont, Samuel J. Tilden, Charles Lanier, G. W. Cass, Francis T. Walker, New York.

Elizabethtown & Paducah.—General Adna Anderson has been appointed General Manager, in place of Gen. R. H. G. Minty, resigned. General Anderson was recently Receiver of the Chicago, Danville & Vincennes, and was formerly Vice-President and General Superintendent of the Toledo, Wabash & Western.

Empire Line.—The following circular is from General Manager Frank J. Firth:

"The duties heretofore attaching to the office of Purchasing Agent will be assumed by the General Manager. All reports and statements relating to maintaining equipment should be addressed to Mr. Frank Staley, Chief Clerk, No. 1,127 Girard street, Philadelphia. The foregoing will take effect Jan. 1, 1878."

Erie.—J. N. Mileham has been appointed Superintendent of Car Repairs at the Jersey City shops of the Erie Railway, in place of J. B. Hill, resigned. Mr. Mileham was formerly Superintendent of the Buffalo Car Company.

Great Southern.—At the annual meeting in New York, Jan. 8, the following directors were chosen: T. W. Osborne, Jacksonville, Fla.; John J. Chapman, Jesup, Ga.; Henry Heth, Richmond, Va.; Thomas J. Latham, Washington; George P. Ihrie, Solomon Turck, New York; A. P. Minear, San Francisco.

Hartford, Providence & Fishkill.—Mr. Amos Pillsbury has been appointed Master Mechanic, in place of Edwin Garfield, deceased. He was for some time foreman under Mr. Garfield.

Longview & Sabine Valley.—At the annual meeting in Longview, Texas, Jan. 4, the old board was re-elected, as follows: Brad Barner, Eli Barner, Samuel Cundiff, C. C. Hanks, George D. Harrison, T. S. S. Young, J. H. McCauley. The board re-elected Brad Barner, President; George D. Harrison, Vice-President; Eli Barner, Secretary and Treasurer.

Memphis & Little Rock.—Mr. R. K. Dow is elected President. Mr. M. B. Prichard remains in charge of the road as General Manager.

Missouri, Kansas & Texas.—The following appointments have recently been made: R. M. Ridgeway, General Roadmaster; George H. Huntington, Superintendent Missouri Division; C. M. Sheaff, Superintendent Sedalia and Fort Scott divisions.

New Haven & Northampton.—At the annual meeting in New Haven, Conn., Jan. 2, the old board was re-elected, as follows: Charles N. Yeamans, Westfield, Mass.; Horatio G. Knight, Easthampton, Mass.; Andrew L. Kidston, Matthew G. Elliott, Harmanus M. Welch, George J. Brush, Daniel Trowbridge, New Haven, Conn.; Wm. Walter Phelps, Teaneck, N. J.; Geo. St. John Sheffield, New York.

New Jersey Midland.—Mr. R. H. Chipman having resigned, Mr. S. W. Beers has been appointed General Freight and Passenger Agent of this road. All communications to those departments should hereafter be addressed to him. His office is at No. 93 Liberty street, New York.

New York Elevated.—At the annual meeting in New York, Jan. 8, the following directors were chosen: Ashbel H. Barney, Alfred S. Barnes, Heber R. Bishop, Benjamin Brewster, James A. Cowing, David Dows, Cyrus W. Field, Edward M. Field, Josiah M. Fiske, John H. Hall, Daniel A. Lindley, John T. Mairs, Wm. T. Pelton. The board re-elected Cyrus W. Field, President; Wm. T. Pelton, Vice-President; James A. Cowing, Secretary and Treasurer; Walter Katte, Chief Engineer; T. T. Onderdonk, Superintendent.

Omaha & Republican Valley.—At the annual meeting in Omaha, Jan. 2, the following directors were chosen: S. H. H. Clarke, Sidney Dillon, Jay Gould, A. J. Poppleton, F. L. Ames, T. L. Kimball, J. W. Gannett. The board elected S. H. H. Clarke, President; Sidney Dillon, Vice-President; J. W. Gannett, Secretary and Treasurer.

Pennsylvania.—Mr. C. W. Cook is appointed General New England Freight Agent for this company, with office in Boston. He has had for some time the agency for Connecticut and Western Massachusetts.

Pullman Car Companies.—The rosters of these companies are published in the *Official Guide*, as follows: *Pullman Palace Car Company.*—General offices, corner Michigan avenue and Adams street, Chicago; New York office, Drexel Building.

George M. Pullman, President; Horace Porter, Vice-President (New York office); A. B. Pullman, Second Vice-President; Charles W. Angell, Secretary; D. N. Welch, General Superintendent; George M. Gray, General Ticket Agent; John Remmer, General Accountant; Wm. Angell, Purchasing Agent; E. H. Goodman, Superintendent Central Division, Philadelphia; E. A. Jewett, Superintendent Chicago Division, Chicago; T. H. Wickes, Superintendent St. Louis Division, St. Louis; W. A. Riach, Superintendent Southern Division, Atlanta, Ga.; H. S. Billings, Superintendent Erie Division, Jersey City, N. J.; T. H. Clark, Superintendent Eastern Division, Montreal; E. H. Marsh, Superintendent Boston Division, Boston; H. S. Roberts, Superintendent European Division, St. Pancras Station, Midland Railway, London, England; and the following assistant superintendents: J. S. Merrill, Baltimore, Md.; J. R. Bennett (Agent), Buffalo, N. Y.; J. P. Meehan, H. M. Bancroft and S. R. Hibbard, Chicago; C. H. Walker, Cincinnati; E. Pagels (Agent), Columbus, O.; F. W. Gates (Agent), Hornellsville, N. Y.; F. T. Harrison (Agent), Houston, Texas; C. D. Flagg, Jersey City, N. J.; T. B. Boothby, Kansas City, Mo.; J. C. Wilson (Agent), Indianapolis; J. N. McCoy, Louisville; Robert Barry (Agent), No. 287 Broadway, N. Y.; Thomas J. McCarthy, New Orleans; J. H. Sims, Philadelphia; M. L. Lawrence, Pittsburgh; C. A. Garcelon, St. Louis; W. F. Banker, Washington, D. C.; J. A. Walker, Wilmington, N. C.; J. R. Wood (Agent), Detroit, Mich. *Pullman Pacific Car Company.*—General office, Omaha, Neb. George M. Pullman, President; D. N. Welch, Vice-President; Charles W. Angell, Secretary: L. M. Bennett, General Superintendent; W. H. J. Stratton, Omaha, Neb., and K. D. Brown (Agent), Ogden, Utah, assistant superintendents. *Pullman Southern Car Company.*—General office, corner Main and Frankfort streets, Louisville, Ky. George M. Pullman, President; D. N. Welch, Vice-President; Charles W. Angell, Secretary; Thomas H. Hays, General Superintendent; assistant superintendents, J. N. McCoy, Louisville; W. A. Riach, Atlanta, Ga.; Thomas J. McCarthy, New Orleans.

St. Louis & Mount Carmel.—This company was recently organized as successor to the Louisville, New Albany & St. Louis by the election of the following directors: Bluford Wilson, Springfield, Ill.; James Churchill, Albion, Ill.; Robert Bell, E. B. Green, Mount Carmel, Ill.; Samuel Bayard, Evansville, Ind.; J. J. Brown, New Albany, Ind.; St. John Boyle, Louisville, Ky. The board elected Robert Bell President; St. John Boyle, Vice-President; George Denlon, Secretary and Treasurer.

Terre Haute & Indianapolis.—At the annual meeting in Terre Haute, Ind., Jan. 7, the old board was re-elected, as follows: J. Collett, F. C. Crawford, W. K. Edwards, Alexander McGregor, W. R. McKeen, D. W. Minshall, W. B. Tuell, all of Terre Haute. The board re-elected W. R. McKeen, President; John E. Simpson, General Manager; W. H. Buckingham, Secretary and Auditor; R. A. Morris, Treasurer.

Washington & Hope.—The officers of this company are: W. H. Carruth, President; R. B. Battle, Secretary; Thomas H. Simms, Treasurer. Offices at Washington, Ark.

PERSONAL.

—Mr. H. S. Master has resigned his position as Assistant Master of Transportation of the Chicago Division, Baltimore & Ohio Railroad.

—Mr. John S. Day denies the report that he is about to resign his position as Superintendent of the Louisville, New Albany & Chicago Railroad.

—Dr. E. D. Standiford, President of the Louisville & Nashville Company, celebrated his 46th birthday on Dec. 28, by a dinner party to a number of personal friends at his residence in Louisville.

—J. C. Walkley, a director and formerly President of the Connecticut Valley Railroad Company, and E. R. Wiggin, also a director and one of the agents for the Trustee in possession of the road, have both been indicted for fraud in connection with the management of the Charter Oak Life Insurance Company.

—Mr. T. B. Sargent has resigned his position as Superintendent of the Illinois Division of the Chicago, Rock Island & Pacific road.

—Mr. Peter C. Doyle has resigned his position as Superintendent of the Buffalo & Jamestown road.

—Mr. W. H. Lewis, who recently retired from his position as Master Mechanic of the Northern Pacific Railroad, was presented with a valuable gold watch by the employes formerly under his charge. The presentation was made on Christmas day, at Brainerd, Minn.

—Mr. A. D. Hepburn has resigned the position of Purchasing Agent for the Empire Line, which he has held for a long time.

—Mr. George W. Bentley declines, "for reasons of a personal and family nature," to accept the position of Second Vice-President and General Manager of the Central Vermont Railroad Company. He prefers to retain his present position as Superintendent of the New London Northern Railroad.

—Mr. R. H. Chipman has resigned the position of General Freight and Passenger Agent of the New Jersey Midland Railway, which he has held for several years.

MEETINGS AND ANNOUNCEMENTS.

Dividends.

Dividends have been declared as follows:

Middletown, Unionville & Water Gap (leased to New Jersey Midland), 3½ per cent., semi-annual, payable Jan. 10.

Little Schuylkill (leased to Philadelphia & Reading), 3¼ per cent., semi-annual, payable on demand.

Terre Haute & Indianapolis, 6 per cent., semi-annual.

Foreclosure Sales.

The sale of the *Chesapeake & Ohio* Railroad, which is to take place in Richmond, Va., April 2, 1878, will be made subject to the claim of the State of West Virginia for taxes, and to the Receiver's certificates issued for taxes due the State of Virginia. The purchasers will have also to assume the payment of the mortgages prior to those under foreclosure of which the road is to be sold, and they will be required to secure the payment of those obligations by the execution of a special trust deed under direction of the Court. Bonds and over-due coupons of the foreclosed mortgages will be received in payment of part of the purchase money; the purchasers will be required to pay $200,000 at the time of the sale, or at such time (not exceeding 90 days thereafter) as the Commissioner may direct; but any sums which the Receiver may in the meantime pay out of the earnings of the road after the day of sale may be deducted from the cash payment required. If the amount paid should exceed the amount of the liens against the road, the surplus must be paid in cash.

Meetings.

Meetings will be held as follows:

Connecticut River, annual meeting, at the office in Springfield, Mass., Jan. 16.

Philadelphia, Wilmington & Baltimore, annual meeting, at the office in Wilmington, Del., Jan. 14, at 1 p. m.

Railroad Claim Agents' Convention, called to meet at the Tremont House in Chicago, Jan. 15, at 10 a. m.

Lehigh Valley, annual meeting, at the office, No. 238 South Third street, Philadelphia, Jan. 15, at noon.

Railroad Claim Agents' Convention.

At a meeting of the claim agents of several Western railroads, held in Chicago Dec. 17, a committee was appointed to request the managers of all railroads in the United States and Canada to send their claim agent, or some qualified person, to represent them at a meeting to be held at the Tremont House, Chicago, beginning at 10 a. m. on Jan. 15. The object of the meeting is to secure a comparison as to the manner of investigation and settlement of claims for loss and damage to freight, robberies of freight in transit, overcharges, shortage and similar claims; also claims for stock killed, injuries to passengers and employes, medical services and the large class of similar claims made against railroad companies. It is believed that such a comparison will be of much benefit, and that many valuable hints and suggestions will be called out. The meeting is approved by several of the largest companies in the West.

The committee consists of Messrs. W. R. Head, Personal Injury Agent, Illinois Central; L. O. Goddard, Secretary to General Solicitor, Chicago, Burlington & Quincy; C. M Wicker, Assistant General Freight Agent, Baltimore & Ohio; D. J. Pridham, Chief Clerk General Claim Department, Chicago & Northwestern; W. F. Peterson, Claim Department, Star Union Line.

TRAFFIC AND EARNINGS.

Railroad Earnings.

Earnings for various periods are reported as follows:

Year ending Sept. 30:

	1876-77.	1875-76.	Inc. or Dec.	P. c.
European & North American, in Maine.	$360,940	.....	....	....
Expenses.....	216,853	.....	.....	....
Net earnings.....	$144,087	.....	.....	....
Earnings per mile..	3,166	.....	.....	....
Per cent. of exps...	60.07	.....	.....	....

Year ending Dec. 31:

	1877.	1876.		
Atchison, Topeka & Santa Fe.....	$2,663,971	$2,474,263	Inc ..	$189,708	7.7
Bur., Cedar Rapids & Northern..	1,249,881	1,128,075	Inc ..	121,806	10.8
Chicago & Alton.....	4,483,558	4,960,528	Dec..	476,970	9.6
Chi., Milwaukee & St. Paul.....	8,116,468	8,054,171	Inc ..	62,289	0.8
Grand Trunk.....	9,417,074	9,272,172	Inc ..	144,902	1.6
Great Western, of Canada.....	3,950,584	3,970,073	Dec..	19,489	0.5
Kansas Pacific.....	3,264,675	3,000,799	Inc ..	263,876	8.8
Missouri Pacific.....	3,834,251	3,714,521	Inc ..	119,730	3.2
Missouri, Kansas & Texas.....	3,174,320	3,217,279	Dec..	42,959	1.3
St. Louis, Alt. & T. H., Belleville Line.....	515,724	498,741	Inc ..	16,983	3.4
St. Louis, Iron Mt. & Southern.....	4,491,088	4,002,044	Inc ..	489,044	12.2
St. Louis, Kan. City & Northern.....	3,150,476	3,143,866	Inc ..	6,610	0.2
Toledo, Peoria & Warsaw.....	1,158,668	1,411,758	Dec..	253,090	17.9
Wabash.....	4,495,693	4,403,615	Inc ..	92,078	2.1

Ten months ending Oct. 31:

Grand Rapids & Indiana.....	$900,377	$960,648	Dec..	$60,271	6.3
Net earnings.....	302,560	268,501	Inc ..	34,059	12.7
Per cent. of exps...	66.20	72.05	Dec..	5.85	8.1

Month of November:

Atlantic & Great Western...	$358,855	$296,313	Inc ..	$62,542	21.1
Central, of Iowa.....	94,462	73,630	Inc ..	20,830	28 3
Net earnings.....	50,475	6,880	Inc ..	43,595	633.6
Per cent. of exps...	46.50	92.00	Dec..	45.50	49.5

Month of December:

Atchison, Topeka & Santa Fe	$231,643	$192,128	Inc ..	$39,515	20.6
Bur., Cedar Rapids & Norther	129,554	90,487	Inc ..	39,067	43.2
Chicago & Alton.....	334,784	374,351	Dec..	39,567	10.6
Chicago, Milwaukee & St. Paul.....	669,000	610,288	Inc ..	58,712	9 6
Kansas Pacific.....	242,003	210,654	Inc ..	31,749	15.1
Missouri, Kansas & Texas.....	256,021	296,466	Dec..	40,445	13 6
Missouri Pacific.....	317,950	324,214	Dec..	6,264	1.9
Michigan Central....	496,629	474,007	Inc ..	22,622	4.8
St. Louis, Alt. & T. H., Belleville Line.....	40,920	54,299	Dec..	13,379	24.6
St. Louis, Iron Mt. & Southern.....	522,100	507,764	Inc ..	14,336	2 8
St. Louis, Kan. City & Northern.....	258,447	261,177	Dec..	2,730	1.0
Toledo, Peoria & Warsaw.....	90,687	98,071	Dec..	7,384	7.5
Wabash.....	361,784	392,068	Dec..	30,284	7.7

Week ending Dec. 28:

Great Western, of Canada.....	$84,700	$59,388	Inc ..	$25,312	42.6

Week ending Dec. 29:

Grand Trunk.....	$167,019	$140,008	Inc..	$27,011	19.3

Eleven months ending Nov. 30:

St. Louis & Southeastern.....	$1,007,191	$999,213	Inc ..	$7,978	0.8
Net earnings.....	225,662	219,146	Inc ..	6,516	3.0
Per cent. of exps...	78.10	78.03	Inc ..	0.07	0 1

Provision Exports.

For the months of November and December, the first half of what is known as the packing season, the exports of hog products from the United States were 144,082,980 lbs., against 162,086,451 lbs. in 1876, showing a decrease of 18,003,471 lbs., or 11⅛ per cent.

Petroleum Movement.

The exports for the year 1877 (lacking one day) and previous years were:

Gallons:

From—	1877.	1876.	1875.	1874.
New York.....	250,707,538	145,237,750	148,391,888	148,092,154
Philadelphia....	47,783,903	67,020,906	63,783,615	72,355,676
Baltimore.....	45,323,737	40,599,744	25,364,853	7,526,735
Boston.....	4,351,428	3,174,890	2,534,081	3,747,859
Richmond....	4,882,314	.....	.....	.....
Portland.....	1,407,984	.....	.....	.....
Norfolk.....	391,100	.....	.....	.....
Total....	354,847,994	256,033,190	240,074,442	231,672,424

Percentages:

New York.....	70.6	56.7	61.8	63.9
Philadelphia..	13.5	26.2	26.6	31.2
Baltimore.....	12.8	15 9	10.5	3.3
Boston.....	1.2	1.2	1.1	1.6
Richmond.....	1.4	....	....	....
Por land.....	0.4	....	....	....
Norfolk.....	0.1	....	....	....
Total.....	100.0	100.0	100.0	100.0

Grain Movement.

Receipts and shipments of grain of all kinds for the week ending Dec. 22 were, in bushels:

	1877.	1876.	Increase.	P. c.
Northwestern receipts.	3,219,829	2,711,045	508,784	18.8
" " shipments.	1,377,864	1,168,217	209,647	18.0
Atlantic ports' receipts.	3,228,910	1,841,227	1,387,683	75.3

Of the Atlantic receipts 31.2 per cent. was at New York, 30.3 at Baltimore, 23.3 at Philadelphia, 7.5 at Boston, 7.0 at New Orleans and 0.7 per cent. at Portland.

Receipts and shipments of grain of all kinds for the week ending Dec. 29 have been, in bushels:

	1877.	1876.	Inc. or Dec.	P. c.
Northwestern receipts...	1,528,048	2,452,664	Dec. 924,616	37.7
" shipments.	1,099,339	964,795	Inc.. 134,544	13.9
Atlantic ports, receipts...	3,561,847	1,882,838	Inc..1,679,009	89.2

While Northwestern receipts continue exceptionally small, by reason of the mud, the shipments are the largest for four years, and the receipts at the Atlantic are nearly twice as great as ever before. Of the latter, 34.7 per cent. was at New York, 24.9 at Philadelphia, 23.8 at Baltimore, 7.6 at New Orleans, 7.5 at Boston, 1.4 at Portland, and 0.1 at Montreal. The total was much greater than in any week last winter.

The figures for the year ending Dec. 31 will probably require considerable revision as fuller returns are received from the companies.

For the year 1877 receipts and shipments have been as follows:

	1877.	1876.	Inc. or Dec.	P. c.
Flour:				
Northwestern receipts.	5,107,531	5,578,950	Dec.. 471,419	8.5
" " shipments.	5,340,423	4,977,845	Inc.. 342,578	6.8
Atlantic receipts.....	8.546,349	9,939,150	Dec.. 1,392,801	14.0
Wheat:				
Northwestern receipts.	53,776,909	55,834,141	Dec.. 2,057,232	3.7
" " shipments	44,633,537	48,799,613	Dec.. 4,166 076	8.2
Atlantic receipts.....	46,000,508	42,740,235	Inc .. 3,260,273	7.7
Corn:				
Northwestern receipts.	77,995,208	81,054,249	Dec.. 3,059,041	3.8
" " shipments.	67,587,819	75,010,881	Dec.. 7,423,062	9.9
Atlantic receipts.....	87,804,025	86,775,163	Inc .. 1,028,862	1.2
Grain of All Kinds:				
Northwestern receipts	169,431,733	173,561,877	Dec.. 4,130,144	2.4
" " shipments.	138,386,343	150,361,872	Dec..11,975,529	8.0
Atlantic receipts.....	166,728,169	163,694,941	Dec.. 3,930,777	1.8

For five years the movement of all grains has been:

	1877.	1876.	1875.	1874.	1873.
N. W. rec'ts..	169,431,733	173,561,877	154,063,413	171,249,249	167,723,758
" shipm's.	138,386,343	150,361,872	124,443,329	127,631,866	134,862,056
Atl. receipts.	166,728,169	163,694,941	136,963,146	139,399,192	125,253,186

Coal Movement.

Complete returns for December have not yet been received, the reports for the closing week of the year usually coming in slowly. The *Engineering and Mining Journal*, the best authority on the coal trade, estimates the total anthracite production, including sales and consumption at mines, as follows:

	1877.	1876.	1875.	1874.
Wyoming Region.....	8,300,000	8,500,000	11,045,998	10,204,764
Lehigh Region.....	4,400,000	3,970,000	2,867,876	4,139.561
Schuylkill Region.....	8,600,000	6,500,000	6,713,113	7,286,793
Loyalsock Region.....	23,000	30,000	16,522	36,268
Totals	21,323,000	19,000,000	20,643,509	21,667,386

The figures for 1876 and 1877 are approximate, the returns not having been fully revised.

The Pennsylvania Coal Company reports its tonnage for the full year as follows:

	1877.	1876.	Inc. or Dec.	P. c.
By Erie Railway.....	976,755	1,032,270	Dec.55,515	5.4
By other lines.....	87,828	54 207	Inc.33,621	62.0
Totals.....	1,064,583	1,086,477	Dec.21,894	2.0

The coal tonnage passed through the Lehigh Canal for the season of navigation was: 1877, 344,992; 1876, 685,194; decrease, 340,202 tons, or 49.7 per cent.

The anthracite coal tonnage of the Belvidere Division, Pennsylvania Railroad, for the year was as follows:

	1877.	1876.	Inc. or Dec	P. c.
Coal Port for shipment.....	60,690	274,679	Dec.. 213,989	77.9
South Amboy for shipment.	564,515	485,772	Inc .. 78,743	16.2
Local distribution on New Jersey lines.....	206,523	187,970	Inc .. 18,553	9.9
Company's use on New Jersey lines.....	71,904	72,250	Dec.. 346	0.5
Total.....	903,632	1,020,671	Dec.. 117,039	11.5

Of the total in 1877, 698,950 tons were from the Lehigh, and 204,682 tons from the Wyoming Region.

At the adjourned meeting of the representatives of the anthracite companies in Philadelphia, Jan. 2, another report was presented by the committee and some changes in the proposed apportionment were brought forward. The representatives of the Lehigh Valley Company and the individual operators of the Lehigh Region, however, declined to vote for any of them, on the ground that the allotment made to them was smaller than they were justly entitled to. This action was subsequently approved by the parties represented. It is not probable that any combination will be made at present.

The individual operators of the Lehigh Region have formed a combination among themselves, chiefly for the purpose of securing uniform rates, and arranging the allotment of cars. They are represented by Dr. G. B. Linderman and Mr. E. P. Wilbur as agents.

Some semi-bituminous and bituminous tonnages for the year are reported as follows:

	1877.	1876.	Inc. or Dec.	P. c.
Cumberland Region, all lines...	1,550,029	1,800,725	Dec.250,696	13.9
Huntingdon & Broad Top R. R..	140,143	159,789	Dec. 19,646	12.3
Barclay R. R.....	336,009	357,159	Dec. 21,150	5.9
Chesapeake & Ohio R. R.....	277,100	236,059	Inc. 41,041	17.4

During the year 1877 the Tennessee Coal & Railroad Company shipped from its mines at Sewanee, Tenn., 103,951 tons, or 9,916 car-loads, of coal, and 1,070,328 bushels, or 2,106 car-loads, of coke. The coal was shipped to various points, nearly one-half going to Nashville; the coke all went to the iron works at Chattanooga and the Rising Fawn Furnace in Georgia.

Shipments to the Pacific.

The New York *Tribune* of Jan. 7 says:

"The rapid increase within the last month or two in the amount of freight offered to the Pacific Mail Steamship Company has resulted in an increase in the rates of freight. It is usual at this season of the year to expect an increase in freight shipments, but this year the increase has gone beyond all expectations, and several steamers have been compelled recently to go to sea leaving a large amount of freight behind them. The company has two steamers running regularly from this port to Aspinwall, the Acapulco and Colon, sailing twice a month. The Crescent City is held as an extra steamer, only sailing when one of the others fails to arrive in time to discharge her freight and reload by the sailing day. If the present increase in freight continues it will become necessary to put the Crescent City on as a regular steamer and run three steamers a month. This company ships freight to all the Western, South American, Mexican and Central American ports, and also to San Francisco, China and Japan, and there is also a line running to Australia and New Zealand. Large quantities of agricultural implements are sent to the South American ports, and an extensive freight business is done in transporting household furniture to the Western coast, householders finding that their furniture, in addition to being carried more cheaply, is less roughly used than by the railroads. Exact figures of the increase in freight carried could not be ascertained, but it was estimated that at least 30,000 tons more were taken across the Isthmus of Darien in 1877 than in 1876. The company regards this great increase as an evidence of awakened business activity."

New York State Canals.

The report of the Canal Auditor for the year ending Sept. 30

gives the earnings and expenses of the New York State Canals as follows:

	1876-77.	1875-76.	Inc. or Dec.	P. c.
Tolls	$1 041,690 66	$1,487,331 55	Dec. $445,640 89	30.0
Rents and miscellaneous	11,679 35	10,001 34	Inc. 1,669 01	16.7
Total receipts	$1,053,361 01	$1 497,332 89	Dec. $443,971 88	29.7
Expenses of repairs	928,701 89	990,023 46	Dec. 61,321 57	6.2
Expenses of collection and management	121,627 79	159,171 15	Dec. 37,543 36	23.6
Total expenses	$1,050,329 68	$1,149,194 61	Dec. $98,864 93	8.6
Surplus	$3,031 33	$348,138 28	Dec. $345,106 95	99.1

Separating the accounts of what are known as the constitutional canals from the lateral canals which the State can dispose of, the results for last year were as follows:

Constitutional Canals:	Revenue.	Cost of repairs and collection.	Surplus or deficit.
Erie	$922,562 81	$692,472 19	Sur. $230,090 62
Champlain	63,161 77	139,216 52	Def. 76,054 75
Oswego	20,473 40	45,549 24	Def. 25,075 84
Cayuga & Seneca	6,631 80	19.307 97	Def. 12,675 17
Totals	$1,012,830 78	$896,545 92	Sur. $116,284 86
Lateral canals:			
Chemung	$3,211 64	$21,706 45	Def. $18,494 81
Chenango	1,159 18	7,722 88	Def. 6,563 75
Black River	15,711 00	54,222 24	Def. 38,511 24
Genesee Valley	19,583 79	70,048 97	Def. 50,515 18
Oneida River Improvement	525 26	.....	Sur. 525 26
Seneca River Improvement	186 92	.....	Sur. 186 92
Cayuga Inlet	166 44	83 21	Sur. 83 23
Crooked Lake	36 00	.....	Sur. 36 00
Totals	$40,530 23	$153,783 76	Def. $113,253 53

The Oneida Lake and Baldwinsville canals earned nothing and cost nothing. The expenses above given do not include $73,031.08 spent from the extraordinary repair fund, although most of this was spent for work coming properly under the head of ordinary repairs.

THE SCRAP HEAP.

Explosion of a Car Heater.

The Burlington (Ia.) *Hawk eye* of Jan. 4 says: "The steam heater in the Pullman sleeping car Princess exploded yesterday afternoon at half-past five o'clock while the car was on the depot platform. A large hole was torn in the roof of the car, and a few of the windows were broken. The explosion made a very loud report and shook all the buildings in the vicinity. Nobody was near the heater at the time, consequently the only damage done was that received by the car. The car was taken east last night to be repaired."

English Locomotives for Australia.

The Government of New South Wales has accepted a bid of Beyer, Peacock & Co., of Manchester, England, to furnish 24 locomotives at £2,780 each. The bid was the lowest of six made by English firms. It is not stated where the engines are to be delivered; if in England the price appears very high.

A Nitro-Glycerine Accident.

On Jan. 2, while a box car on the Chicago & Northwestern road was being loaded with nitro-glycerine at the Jackson Mine, near Negaunee, Mich., the whole mass exploded from some unknown cause, completely demolishing the car and killing seven men. A locomotive attached to the car was lifted from the track and thrown nearly 50 feet, being badly wrecked. Three of the men were employes of the nitro-glycerine works and were in or about the car; they were blown to atoms, the largest piece of any of them found weighing less than two pounds. The other four were trainmen and were all on the engine; they also were instantly killed, nearly all their bones being broken and the flesh stripped from the exposed portions of their bodies. Much damage was done to the town of Negaunee near by, and the shock was felt at Ishpeming, several miles away.

A Bull in a Baggage Car.

The Dayton (O.) *Journal* says: "On Monday a fine Durham bull was shipped from Jamestown to Dayton, over the D. & S. E., to be transferred here to the D. & W. road. As there were no others coming with him, the animal was hitched in one corner of a baggage car. The train arrived on Monday night, and on Tuesday morning it was desired to get his bovine majesty out of the car. But, an intimation that the animal was vicious having gotten abroad during the night, none of the employes felt like venturing in. Finally, however, an intrepid Hibernian, John MacMahon volunteered. He entered the end door, while his companions stood on the depot platform at the side of the car to await developments They hadn't long to wait. Within a second after MacMahon's entrance, sounds of commotion were heard, together with cries of "Open the door! open the door! open the door, quick!' Those in waiting shoved the side door to one side, when MacMahon was just as earnest to have it closed as before to have it opened, for fear that it would enable the animal to see him. As soon as he had entered, Master Taurus had caught him on his horns and tossed him into a corner. His tether not being long enough, he was unable to reach him again, and so there MacMahon crouched until his friends obtained a long plank and pried the bull over to one side, so that he could get out. Safely on the outside, Mr. MacMahon wanted no more bull in his'n, and finally the depot men were obliged to procure a butcher to help to get the bull out of the car. By means of ropes attached to a ring in his nose, two men were able to lead him to the depot."

Train Wreckers.

Virginia courts have no mercy on train-wreckers. At Harrisonburg last week one Ettenger, who placed obstructions on the track of the Valley Branch of the Baltimore & Ohio, causing the wreck of a train and the loss of two lives, was convicted of murder in the second degree and sentenced to 18 years' imprisonment.

Another train-wrecker is now on trial in South Carolina, who succeeded in throwing a train on the Savannah & Charleston road off the track. His excuse is that a turkey belonging to him was killed on the road, and he wanted to get even. It must have been a valuable turkey.

The Highest Foundry in the World.

Mr. George T. Gregory, who has just returned from Peru, where he was in charge of the railroad foundries established by the late Henry Meigga, informs us that in November last he erected and worked an iron foundry at the Cerro de Pasco silver mines, 14,200 feet above the level of the sea, and he believes it to be the highest point at which iron has ever been melted. All the materials for the foundry had to be transported on mules from the terminus of the railroad from Callao. The cupola was 20 inches diameter inside; the fuel used was anthracite coal from Pennsylvania, and the moulding sand came from Albany, N. Y. At that height above the sea the barometric pressure is only 17.03 inches, and to supply the blast a No. 5 Sturtevant blower was used, running 2,160 revolutions. The object was to prove that iron could be melted there without difficulty, as it is intended to build improved machinery for working the Cerro de Pasco ores, and it is not possible to transport heavy castings over the mountains. A number of successful casts were made.

OLD AND NEW ROADS.

Albert.

A special meeting of stockholders is to be held in Hillsborough, N. B., Jan. 21, to vote on the question of issuing $600,000 in 6 per cent. bonds, and of authorizing the execution of a mortgage on the road as security for these bonds.

Alabama & Chattanooga.

Baron Erlanger, of Frankfort, as representing the purchasers of this road at the last sale, has asked for an extension of time for the payment of the balance of the bid, $190,000. An extension has been granted until the January term of the Court.

The Receivers' certificates are now quoted at from 30 to 40 cents on the dollar.

Animas Valley.

A company by this name has been organized to build a railroad from Animas Forks, in San Juan County, Colorado, by way of Eureka, Silverton and Elbert to a terminus on the Animas River, about 60 miles from the starting point. Several short branches are also included in the project.

Bismarck, Fort Lincoln & Black Hills.

A company by this name has been organized to build a railroad from Bismarck, Dakota, the terminus of the Northern Pacific, to some point in the Black Hills region, by the Fort Lincoln route.

Boston & Albany.

The new car shops at Springfield, Mass., are now completed and in full operation. They have been rebuilt on the site of the old shops, which were destroyed by fire some months ago, and are in many respects improved, being supplied with tools of the latest patterns. Some of the heavier tools damaged by the fire have been repaired and put in use again. The boilers which supply steam to the shop engines are fed with the refuse of the wood shops, the shavings and saw-dust being conveyed to the boiler-house through pipes about 400 feet long, a large blower being attached to the main pipe.

Canada Southern.

This company publishes the following notice:

"The scheme presented for the funding of the bonds of the company has been accepted by a large majority of the bondholders. In order to perfect the same and to deliver the new bonds with the proposed guaranty to those who have already deposited their old bonds and to those who may desire to come in, it is necessary that the bonds now outstanding should be presented at the office of the company on or before the first day of February next, so that the same may be exchanged for the certificates of the company to be countersigned by the Union Trust Company.

"It is expected that the prompt compliance by the bondholders with this notice will enable the company to complete the issue of the new bonds on or before the fifteenth day of March next."

Central, of New Jersey.

A meeting of the bondholders of the Lehigh & Wilkesbarre Coal Company was held in New York, Jan. 4, to receive the report of the committee appointed at a previous meeting to consult with the officers of the Central Railroad Company and to prepare a new plan of reorganization for the Coal Company. The committee reported a plan which provides that bonds held by the public at large, amounting to $4,700,000 shall be preferred (this does not include bonds hypothecated by the Central Railroad of New Jersey, amounting to about $6,000,000); that coupons falling due during the next three years shall be funded into ten years 7 per cent. income bonds; that a sinking fund of 10 cents per ton on the amount of coal mined each year shall be set aside for payment, in the first place, of any prior purchase money mortgage and next for the retirement of sterling mortgag bonds, then for cancellation of new income bonds above mentioned, and finally for retirement of $4,700,000 bonds held by the public, and that the earnings of the coal company shall be applied to the payment of interest as follows: First, on prior mortgage and sterling bonds; second, on bonds held by public; third, on income bonds, and fourth, on bonds hypothecated by the Central Railroad. If the earnings in any one year are not sufficient to pay the interest on the income bonds and on the bonds hypothecated by the Central Railroad, such interest shall not be cumulative, but the Central Railroad Company shall cancel any thus remaining unpaid. In view of these considerations, bondholders shall release endorsement of bonds made by the Central Railroad of New Jersey.

The bondholders present voted to adopt the plan as presented.

A meeting of stockholders was held in New York, Jan. 8, to consider a plan of reorganization. The meeting was a private one, but it is said that a plan was presented and adopted which differs materially from the one heretofore prepared and submitted by the joint committees.

Cincinnati, Wabash & Michigan.

The trustees under the mortgage have taken formal possession of this road and will operate it for the benefit of the bondholders. The road extends from Goshen, Ind., southward to Anderson, 114 miles, and has a funded debt of about $1,800,000. In January, 1876, holders were asked to fund their coupons in order to allow the company to complete the road to Anderson. Since then interest has not been regularly paid, although some bondholders have, it is said, received part of the coupons due.

Connecticut Valley.

Holders of over one-third of the first-mortgage bonds have signed the petition requesting the State Treasurer of Connecticut to take possession of this road in their interest, as provided by law; he now holds it on behalf of the second-mortgage bondholders. Should the default continue until July 1, that is one year, a foreclosure can be had.

Chicago, St. Louis & New Orleans.

The following circular is dated at New Orleans, Dec. 26:

"The New Orleans, Jackson & Northern Railroad Company, and the Mississippi Central Railroad Company, having been merged into one corporation, under the title of the Chicago, St. Louis & New Orleans Railroad Company, by an act of consolidation on the 8th of November, ultimo, the practical consolidation of the line from New Orleans to Cairo, will take effect on the first day of January, 1878.

"All roads are, therefore, requested to close their accounts with the New Orleans, Jackson & Northern Railroad Company, and with the Receiver of the Mississippi Central Railroad, with December business, transferring such balances as may appear on their books on the 1st of January to account of the Chicago, St. Louis & New Orleans Railroad Company.

"All drafts for balances due either by the New Orleans, Jackson & Northern Railroad Company, or by the Receiver of the Mississippi Central Railroad, should be drawn on R. S. Charles, Treasurer, at New Orleans. Drafts for balances due to either of the above accounts will be drawn by the undersigned (S. B. McConnico, Auditor).

"Coupon ticket reports for the consolidated line should be made to, and will emanate from, this office. Reports of mileage of all cars belonging to either of the corporations herein mentioned should be made to this office—embracing the following initials, viz.: 'N. O., J. & G. R. R.' 'N. O., J. & N. R. R.' 'Miss. Cent. R. R.' 'So. R. R. Assn.' 'N. O., St. L. & C. R. R.' 'C., St. L. & N. O. R. R.' 'Ills. Cent. R. R.' 'M.' 'J. C. C.' and 'W. K. A.,' as per printed list furnished.

"All offices of the late New Orleans, Jackson & Northern Railroad Company being continued in their respective positions by the management of the consolidated line, all reports, accounts and communications other than those mentioned should be addressed as heretofore."

Detroit & Milwaukee.

At the opening of the January term of the Wayne Circuit Court at Detroit last week, counsel for the first-mortgage bondholders asked the Court to set a day for the trial of the foreclosure suit. After some discussion between counsel, the case was passed for the present, but the Court agreed to set a day, when the trial of chancery cases was begun.

It is said that Col. Barker, of Hamilton, Ont., counsel for the Great Western Company, is charged with a new proposition from the English bondholders.

Duxbury & Cohasset.

The town of Plymouth, Mass., has transferred its $40,000 stock in this road to the Old Colony Company, at the valuation fixed by the Railroad Commissioners. The other towns interested will probably take the same action.

Erie.

Argument on the various cross suits and motions pending on the McHenry intervention in the foreclosure suit was begun before the New York Supreme Court Jan. 3. The principal argument of that day was on the motion to enjoin McHenry and his associates from continuing the proceedings begun by them in Monroe County.

Argument was continued on the following day, when an adjournment was had until this week, no final result having been reached on any of the motions.

European & North American.

At a recent meeting of the bondholders in Bangor, Me., the trustees under the land-grant mortgage, who are in possession of the road, reported the earnings of the road in Maine for the year ending Sept. 30 last as follows:

Gross earnings ($3,166 per mile)	$360,940
Expenses (60.07 per cent.)	216,853
Net earnings ($1,264 per mile)	$144,087

A new contract has been made with the Bangor & Bucksport Company, which gives the European & North American Company 75 per cent of the gross earnings, the Bucksport road to keep up its line and assume all risks. The gauge has been narrowed between Bangor and Vanceborough; also on the Western Extension, Fredericton Branch, New Brunswick & Canada and Bucksport roads. Freight and passenger traffic have held good through the year. The trustees mention that several suits are still in process of litigation, and anticipate results favorable to the company. The cashier's report shows a balance of $74,255, after paying certain liabilities, and some $24,000 on account of the change of gauge, and gives a statement of payments to meet, from Oct. 1, 1877, to Oct. 1, 1878, aggregating $72,689.

Georgia.

It will be remembered that some time ago the State of Georgia attempted to enforce the payment of taxes upon the property of the Georgia Railroad Company, but the courts decided the suits then brought in favor of the company. Recently, however, the Attorney General of the State, after investigation, has given it as his opinion that this decision does not cover several grounds upon which the State of Georgia claims the right to levy taxes on the Georgia Railroad & Banking Company, and acting upon this opinion and by the advice of the Attorney General, the State Comptroller has issued executions for the amounts claimed as taxes for 1875, 1876 and 1877, with the penalties thereon to the Sheriff of Richmond County, with instructions to levy on the property. The amount of taxes and penalties is about $212 000. The company will at once apply to the courts to enjoin further proceedings.

Great Southern.

At the annual meeting in New York, Jan. 8, the stockholders voted to increase the capital stock from $10,000,000 to $14,000,000. The company's road is to extend from Millen, Ga., to a point near the southern extremity of Florida, and it claims to have some work done between Jesup, Ga., and Jacksonville, Fla. The right of way and such property as the company had in Georgia was sold at Receiver's sale last July.

Houston & Texas Central.

Messrs. John J. Cisco & Co. publish the following telegram from Mr. E. W. Cave, Treasurer of the company: "The indebtedness of the Houston & Texas Central Railroad to the Missouri, Kansas & Texas Railway Company, the Union Trust Company, Trustee, has been adjusted on a basis satisfactory to the respective companies; all suits are dismissed, and every obstacle removed which has stood in the way of the most cordial business relations between the two railroad companies."

Illinois & Michigan Canal.

At a recent meeting of the Illinois Canal Commissioners, Col. Jenne, the Chief Engineer, presented his annual report. The work on the lock and dam at Copperas Creek for the improvement of the Illinois River has been completed and in use since Oct. 23 last. This makes 90 miles of completed navigation, with seven feet depth of water at all seasons of the year when the river is open. The total cost of the whole work was $410,107,31 of which $347,747.31 was expended by the State and $62,359,80 by the United States. The original estimate was $427,493, and was made in December, 1870. Details of the construction of the Spring Lake Canal, or outlet to the Illinois River, are also given. The cost of the work was $4,485,40, to which will be added the cost of condemning the land appropriated for the same.

It is estimated that, if the funds were provided, the locks and dams could be built in three years. It would require say, $350,000 the first year, $450,000 the second year and $550,000 the last year; the net revenues of the canal and locks on the river ought to produce $350,000 by the time this work is completed. This will leave $1,000,000 to be provided from other sources in the three years, which can all be repaid, with the interest, in five years after its completion, from the increased revenues of the canal and river.

Concerning the future improvement of the Illinois River, the report says that it will require three more locks and dams to complete the improvement, which is estimated to cost $1,350,000, one lock to be located at Beardstown, or a few miles below, one at or near Bedford, and the other about six miles above the mouth of the river. The report estimates that with these improvements canal boats can transport freight from St. Louis to Chicago at a profit for a rate of one-half cent per ton per mile. Carrying grain from St. Louis, a round trip could be made in two weeks, the distance being about 370 miles each way, and at a rate of $1.85 per ton, after deducting tolls, the receipts of the boats would be $1.40 per ton. Eight canal boats and a propeller or a tug can pass each lock on the river at one lockage, and all would carry from 1,800 to 2,000 tons of freight, giving not less than $2,500 above tolls. For the return trip from Chicago these same boats would transport from 1,000,000 to 1,200,000 feet of pine lumber at $3 per thousand, making freight bills not less than $2,500 above tolls.

Kansas Pacific.

The joint committee, representing the Stuttgart, Frankfort and Bremen bondholders' committees, has broken up, owing to a disagreement among the members. The Frankfort and Bremen committees will continue to act together, as heretofore, but the Stuttgart committee withdraws altogether.

Lehigh Valley.

A correspondent of the Philadelphia *Times*, writing from Bethlehem, Pa., says: "The Lehigh Valley Railroad Company have had for some weeks past a large force of men at work in building a railway through the Meadows, along the Jordan Creek, at Allentown. There has been much speculation as to the object of this branch road and its ultimate destination. To the uninitiated there doesn't appear to be any very great necessity for a road in this direction. The popular rumor at Allentown is that by building this branch the Lehigh Valley people hope to prevent the Philadelphia & Reading Company from crossing the Valley road and thus form a junction with the Lehigh & Susquehanna Railroad. There is nothing in this report, of course. Mr. Sayre, of the Lehigh Valley Railroad, says that their road is building this line under an agreement with the Little Lehigh Valley Railroad Company and that they have nothing further to do with it. The Little Lehigh Valley Railroad Company is a chartered concern of some years' standing and Charles W. Cooper, the Allentown banker, is its President. The object of the branch is said to be the opening to business and industrial purposes these otherwise useless meadows and to bring coal yards closer to the city. Some day it is hoped to run passenger trains upon this road, but for the present no depot will be established upon it."

Louisville, New Albany & St. Louis.

The bondholders who bought this road at foreclosure sale have organized a new company under the name of the St. Louis & Mt. Carmel Railroad Company, the new organization apparently covering only that part of the road in Illinois. The road is in operation from Princeton, Ind., to Albion, Ill., 29 miles, about 19 miles being on the Illinois side of the Wabash.

Madeira & Mamore.

The London *Railway News* of Dec. 22 says:

"It has been already announced that a contract has been signed with a Philadelphia firm for the construction of this line, which has been the subject of so much useless litigation in this country. It is to be regretted that a work in which so many English interests are involved has been taken out of English hands, but the bondholders who have been waging a prolonged contest with Colonel Church, the agent of the Bolivian Government, have themselves to blame for the action he has at last taken in seeking in America the support denied him here in carrying out the scheme for which funds were duly provided and have been so long lying idle in the Bank of England. Under the circumstances, it is a satisfactory feature that the work has been undertaken by a well-known and enterprising firm of contractors, in whose hands there seems every probability of a speedy completion of a work of vast importance to the development of South American trade, and which promises to prove a remunerative investment.

"We have recently had an opportunity of inspecting the contract which is concluded between Messrs. P. & T. Collins, of Philadelphia, and Colonel Church, as agent for the Madeira & Mamore Railway Company. The price fixed by the contract is £5,900 per mile of road completed, up to the length estimated by Colonel Church of 180 miles. For any length of main line beyond this distance the price is to be reduced to £5,200, so that the contractors will have no inducement to extend the work, as has been intimated by opponents to the scheme. Towards the payments under this contract the funds in the Bank of England, amounting to about £720,000, are available, and for the balance the contractors agree to take debentures guaranteed by the Brazilian Government. Such guarantee to the extent of £400,000 has, we learn, been promulgated, and telegraphic advices just to hand state that the decree has been finally published. The contract, however, being signed before the settlement of the question by the Brazilian Chambers, a stipulation was inserted that should there be any difficulty about obtaining the guarantee, the contractors were to take the simple debentures of the company. As caution money, the contractors agree to pay $200,000 gold, which amount, we understand, has already been deposited with Messrs. McCalmont Brothers & Co."

Manchester & Keene.

The six miles of this road lately completed from Greenfield, N. H., to Hancock will be operated by the Nashua & Lowell Company under a temporary lease. The new road forms an extension of the Peterboro Railroad, which the Nashua & Lowell already leases.

Mansfield, Coldwater & Lake Michigan.

The Pennsylvania Company makes the following announcement: "The Northwestern Ohio Railroad Company having purchased that portion of the late Mansfield, Coldwater & Lake Michigan Railroad situated between Tiffin and Mansfield, O., and having arranged with the Pennsylvania Company to operate the same, said railroad will, on and after Jan. 1, 1878, constitute part of the Northwestern Ohio Railroad, and will be known and operated as such by this company."

The road was sold in foreclosure last August and bought in by the bondholders. It has always been worked by the Pennsylvania Company, so that the present change is merely a formal one.

Maryland & Delaware Ship Canal.

This company was organized several years ago to connect Chesapeake Bay with the Delaware Bay by a ship canal on what is known as the Sassafras River route. This line requires a canal about 17 miles long and the deepening and improvement of the Sassafras River for 13 miles from its mouth. The route of the proposed canal and the Sassafras River is from near Bombay Hook on the Delaware nearly due west across Delaware and the Eastern Shore of Maryland, the mouth of the Sassafras being on the east side of Chesapeake Bay and some 20 miles above the mouth of the Patapsco, on which Baltimore is situated. It is said that the company is preparing a formal petition to the city authorities of Baltimore for the endorsement of the city on $500,000 of its bonds.

Mexican Railroad Projects.

A telegram from the city of Mexico says: "Congress, before adjourning, authorized the construction of the following railroads: From the City of Mexico to Morelia; from Cetaya to Palmillas and Ometuses to Pacuca.

Missouri, Iowa & Nebraska.

This company, the St. Louis, Keokuk & Northwestern and the Keokuk & Des Moines have at last completed agreements for the use of the tracks in Keokuk, Ia., necessary to carry out the new terminal arrangements of the first two roads there. It is expected that everything will be completed and that the Missouri, Iowa & Nebraska will begin to run its trains into Keokuk this month, using the St. Louis, Keokuk & Northwestern track from its old terminus at Alexandria, Mo.

Missouri Pacific.

A compromise has been agreed upon as to the Carondelet Branch bonds upon which default was made last October. The bondholders agree to surrender their bonds and receive 50 per cent. of their face in new bonds, the company to pay the accrued interest and to pay the coupons on the new bonds promptly as they accrue. The amount of these bonds is $500,000, and they are a first lien on the 15¾ miles of the branch from Kirkwood to Carondelet.

Montclair & Greenwood Lake.

The committees representing the first and second-mortgage bondholders have held several meetings lately to propose a plan of reorganization. It is probable that a plan will be agreed upon and that it will include provision for the extension of the road from Greenwood Lake to Montgomery (26 miles) to connect with the Wallkill Valley road.

New York & New England.

The special committee appointed last year to consider the condition of this road has presented two reports to the Massachusetts Legislature. The majority report recommends that the State should come to a final settlement with the company, as far as possible, and at once dispose of all its interest in the property. The minority report recommends that the State join with the other owners of the road in putting it in a sound and manageable condition, and urges that the State could probably secure a larger return for the money invested in this way than by selling its interest.

New York Elevated.

At the annual meeting in New York, Jan. 8, President Field stated that the company had no floating debt, that it had a large balance in bank and subscriptions from responsible parties, payable as required to an amount sufficient to complete all the work now under way both for the second track on the present line and for the new east-side line.

The number of passengers carried on the road now in operation for the past year was: 1877, 3,292,161; 1876, 2,268,960; increase, 1,023,201, or 45.1 per cent.

Olean, Bradford & Warren.

The track of this narrow-gauge road was completed on Dec. 29, from the junction with the Buffalo, New York & Philadelphia road at Olean, N. Y., west by south to the Pennsylvania State line near Gillmor City, a distance of 12½ miles. The road has been very quickly built, work having been begun on Oct. 29, just two months before

The road will be extended to Bradford, Pa., by a company of the same name organized in Pennsylvania, which has already five miles completed and is pushing work on 4½ miles still unfinished. The new line gives the Buffalo, New York & Philadelphia a connection with the Bradford oil region.

Petersburg.

A meeting of bondholders was held in Baltimore, Jan. 7, for the purpose of taking some action to protect their interests in the suits now pending against the company in the United States Circuit Court for the Eastern District of Virginia. After considerable discussion a resolution was adopted to the effect that the interest of all parties in the road will be best promoted by the earliest sale of the same under a proper decree of the court. Douglas Gordon, Andrew W. Reid and J. B. Senner were appointed a committee to consult with the trustees to further the purpose of the resolution and take whatever other steps that would be necessary to protect the interests of the bondholders in any sale of the road that may be ordered.

Philadelphia, Newtown & New York.

The extension of 12 miles from Fox Chase, Pa., north by east to Newtown is now all ready for the rails, except two cuts on which a little work remains to be done. The mason work is all finished and only four small bridges are yet without the superstructure. The trestle work over the New York & Philadelphia New Line at Bethayres is up, and the track can be laid in very short time. A commencement has been made on the tracklaying at Fox Chase.

Pittsburgh, Castle Shannon & Washington.

This company, which is organized for the extension of the old Pittsburgh & Castle Shannon road, has its road graded from Castle Shannon, Pa., southward to Right's, 14 miles, and track laid for eight miles. Work is progressing and the whole 14 miles is to be completed by Feb. 1. A branch of four miles, to Washington, is graded and track will be laid as soon as the main line is done. An extension is projected and partly located from Finleyville, 12 miles south of Castle Shannon, directly southward to Morgantown, W. Va., 60 miles, and contracts have been let for the grading, bridging and tieing of 14 miles, to be done by June 10.

In West Virginia a company is being organized, to be known as the Pittsburgh, West Virginia & Southern, to extend the road from Morgantown by way of Grafton and the valleys of the Tygart and Green Briar rivers to a point on the Chesapeake & Ohio, six miles west of the White Sulphur Springs. The object is to secure to Pittsburgh the trade of the country south of it.

Pittsburgh, Wheeling & Kentucky.

The track on this road is now laid to the outskirts of Wheeling, W. Va., about thirteen miles beyond the late terminus at Wellsburg and 23 miles southward from the junction with the Pittsburgh, Cincinnati & St. Louis at Holliday's Cove. But a short time will be required to finish the track into Wheeling.

Portland & Ogdensburg.

In the United States Circuit Court at Burlington, Vt., Jan. 5, a new bill of foreclosure was filed against the Vermont Division by Charles W. Hassler as attorney for certain bondholders who did not give their consent to the issue of the preferred mortgage bonds.

Raleigh & Seaboard.

An officer of the Jamesville & Washington road, who evidently does not believe in narrow gauge, writes to the Raleigh (N. C.) *News* as follows: "The proposed Raleigh & Seaboard Line does not propose to cross the Wilmington & Weldon Railroad at Rocky Mount. It runs about four miles south, and is an independent line to Tarboro, and broad gauge, the same as ours. I reckon it would be a grave mistake to mix up the 3 ft. gauge with our 4 ft. 8½ in., which can be constructed so cheaply in our State *(as I have proved)*, and brings into unison with those roads already constructed. I calculate that an air line from Raleigh, via Tarboro, to the middle of our road, and in the centre of the country between the Roanoke and Tar Rivers, would not exceed 90 miles in length, thus bringing the capitol of the State within 100 miles of the deep water on the Pamlico, with direct and free access to the sea, through Hatteras Inlet, say 60 miles further. Of this 100 miles 11 are in successful operation on our road, about eight are laid with iron from Tarboro towards Bethel, and say 10 more graded towards the Jamesville & Washington Railroad & Land Company's road; so that only 60 miles remain to be built, which, at the present low price for iron and labor, need not cost above $5,000 per mile. We have a fine locomotive to spare, which would skip over the distance pretty quickly. This route has the double advantage of connection with the South and North. The connection once made, parties could reach either point, say Washington on the Pamlico, or Jamesville on the Roanoke, in five hours or less with quick trains."

There is good navigation from both Jamesville and Washington. A further extension is also suggested through Pantego and Swindett to a point on Pamlico Sound near Lake Mattamuskeet, where there is water enough for large vessels.

Richmond & Danville.

The repairs of the Staunton River bridge and of all other damage caused by the recent freshets have been completed. Through passenger and freight trains are now running as usual.

Rochester & State Line.

Since our last notes concerning this road 36 miles of track have been laid on the gaps between Gainesville, N. Y., and Machias, and between Ellicottville and Salamanca. This makes 103 miles laid in all, leaving only five miles to complete the whole line of 108 miles from Rochester to Salamanca. It is expected that all the track will be down this week. Last week 80 miles of road had been ballasted; three construction trains were at work and another is put on this week.

Seaboard & Roanoke.

The temporary trestle-bridge over the Roanoke at Weldon, N. C., has been repaired so that trains are again running over it. It was moved slightly by the freshet of last week, and was only saved by attaching heavy hawsers to the bridge, which were then carried and made fast to points on shore. The permanent iron bridge will be erected as soon as the masonry can be built; it will be 54 feet above low water, and the piers will be built to stand under any possible freshet.

Seaboard Pipe Line.

A dispatch from Baltimore, Jan. 3, says: "The *American* this morning states that deeds were recorded yesterday at Annapolis covering the transfer to Mr. Herman Haupt, of Philadelphia, of 300 acres of land on Curtis Creek, at a price of $250 an acre. Mr. Haupt is the leading spirit in the seaboard pipe line enterprise, and the purchase of land is made in that interest. The vast combination effected by the Standard Oil Company controls all the existing coal oil refineries, so that the new pipe line must have its own refineries, which will be located at its property on Curtis Creek, just below the Quarantine station. * * *

"Gen. H. Haupt, who is the Chief Engineer and Agent of the company, has secured the right of way from Butler County, Pa., to Curtis Creek, in Anne Arundel County, a few miles from Baltimore, in the harbor of Baltimore. Gen. Haupt has obtained land from every owner along the line established by him in his own name for the seaboard line, leaving no gap in the route, and the company will not have to resort to condemnation proceedings. The distance from the Butler County terminus to Baltimore is 230 miles, 40 miles of which are in Maryland. The line to Baltimore is designed to be a trunk line, with connections from the Pennsylvania terminus and from different points on the route. Its transporting capacity will be 6,000 barrels of oil per day, and it will operate incessantly day and night. The quantity proposed to be brought to Baltimore annually is about two million barrels of crude oil, about equal to the quantity now brought here by two railroads of refined and crude. The company will proceed with the work immediately after the close of the winter, and expect to have the line laid the entire distance during the coming summer. An extensive refinery will be erected at Curtis Creek and a barrel manufactory. There has been very little opposition to granting the right of way to the company, and their dealings with farmers and others are said to have been very liberal."

Springfield, Athol & Northeastern.

The Springfield *Republican* says that orders have been issued that hereafter all freight to and from stations on this road must be sent by way of Springfield. All freight shipped by the Fitchburg road must be billed at local rates to Athol. It is said that this will take 25 or 30 car-loads a week away from the Fitchburg road.

St. Louis & Southeastern.

The Auditor's report for November is as follows:

	St. Louis Div.	Kentucky Div.	Tennessee Div.	Entire Line.
Gross earnings	$55,489 26	$27,368 77	$10,793 25	$93,601 30
Expenses	41,293 16	23,272 89	8,836 02	72,401 57
Net earnings	$14,146 10	$5,096 40	$1,957 23	$21,199 73
Per cent. of expenses	75.08	81.58	81.62	77.35

As compared with November, 1876, the entire line shows a decrease of $2,438.30, or 2.5 per cent., in gross, and of $6,588.39, or 23.7 per cent., in net earnings.

Troy & Greenfield.

Governor Rice, of Massachusetts, in his annual message sums up his recommendations as to the policy to be pursued by the State as to the Troy & Greenfield road and the Hoosac Tunnel in the following paragraph:

"It does not seem to me practicable, in the present state of things, for the Commonwealth to initiate any new policy in regard to the tunnel enterprise. Its property is a section of inland railroad, forming, it is true, a section of a trunk line composed of different corporations, and with indefinite western connections, which divide with it the volume of eastward-bound freight from the great States of the West. It does not appear possible at present to make a permanent connection with any new line west of the Hudson River without an outlay of new capital, which the people of the Commonwealth neither desire nor would justify. Enterprises appear to be developing which will ultimately, and that very soon, utilize the State property under consideration, in a degree somewhat commensurate with the original expectation; and, in the absence of an aggressive policy which is practicable, it seems the part of wisdom and of necessity to wait for a while the approach of such connections as shall present the greatest advantages of strength and enterprise. I cannot but repeat my previously expressed conviction of the expediency of separating the treasury of this railroad from the treasury of the Commonwealth, and of relieving the executive department of the government of its supervision, by placing the road under corporate management familiar with railroad business, and competent to insure proper connections by negotiation when opportunity shall offer."

In minor matters the Governor recommends a limitation of time for the presentation of claims for land damages; some provision for union depots at North Adams and Greenfield, and some legislation to determine the responsibility of companies using the road for damages arising from accidents. With respect to the tolls, he says:

"The method of collecting tolls has been changed since July last, from a fixed rate per ton to a percentage of two-thirds of the gross receipts; thus allowing a flexible instead of a fixed rate."

For the three months reported since the change, that is, from July 1 to Sept. 30, the receipts from tolls were:

From Fitchburg Railroad	$36,353 80
From Troy & Boston Railroad	8,846 15
Total	$45,199 95
Expenses	16,485 26
Net receipts	$28,714 69

For the same period in 1876 the net receipts were $7,296.50, showing an increase of $21,418.19, or 293.4 per cent. For the nine months from Jan. 1, to Sept. 30, the net receipts were: 1877, $63,966.47; 1875, $28,394.36; increase, $35,572.11, or 125.3 per cent.

Wisconsin Central.

The application for a receiver for this company and the Phillips & Colby Construction Company, made by certain creditors, was heard before the United States Circuit Court last week. At the close of the hearing Judge Drummond agreed to appoint a receiver for the Construction Company with qualified powers. He declined to appoint a receiver for the Wisconsin Central, but, in order to protect any equities which the Court might ultimately decide to rest in the plaintiffs, he directed the officers of the company to make a report of receipts and expenditures every two months, and not to pay out any surplus funds without an order from the Court.